DECEMBER 1937
VOLUME 15
NUMBER 4

MODERN PLASTICS

E. F. LOUGEE, Editor
C. A. BRESKIN, Publisher
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Cover color this month is AZTEC RED (created by Textile Color Card Association)

Next Month

General Electric Company has recently coordinated its plastics activities at Pittsfield, Mass., where a new plant, housing 340 molding presses, has been equipped. From laboratories to inspection and shipping departments this is one of the most interesting molding plants in the country so we shall picture and describe it in our January number.

Published the 5th of each month, by Breskin & Charlton Publishing Corporation. Publication office, 20th and Northampton Sts., Easton, Pa. Advertising, editorial and general offices at 425 Fourth Ave., New York, N. Y. Telephone Ashland 4-0655. Western office, 221 N. La Salle St., Room 620, Chicago, Illinois. Telephone Randolph 6336.

PUBLISHERS OF MODERN PACKAGING, PACKAGING CATALOG, MODERN PLASTICS

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Subscription price $5.00 per year in United States, its possessions, and Canada. All other countries, $6.00 per year. Price this issue 50c per copy. Copyright 1937 by Breskin & Charlton Publishing Corporation. All rights reserved. Published in U. S. A. Acceptance under the Act of June 5, 1934, at Easton, Pa., authorized Nov. 24, 1936.
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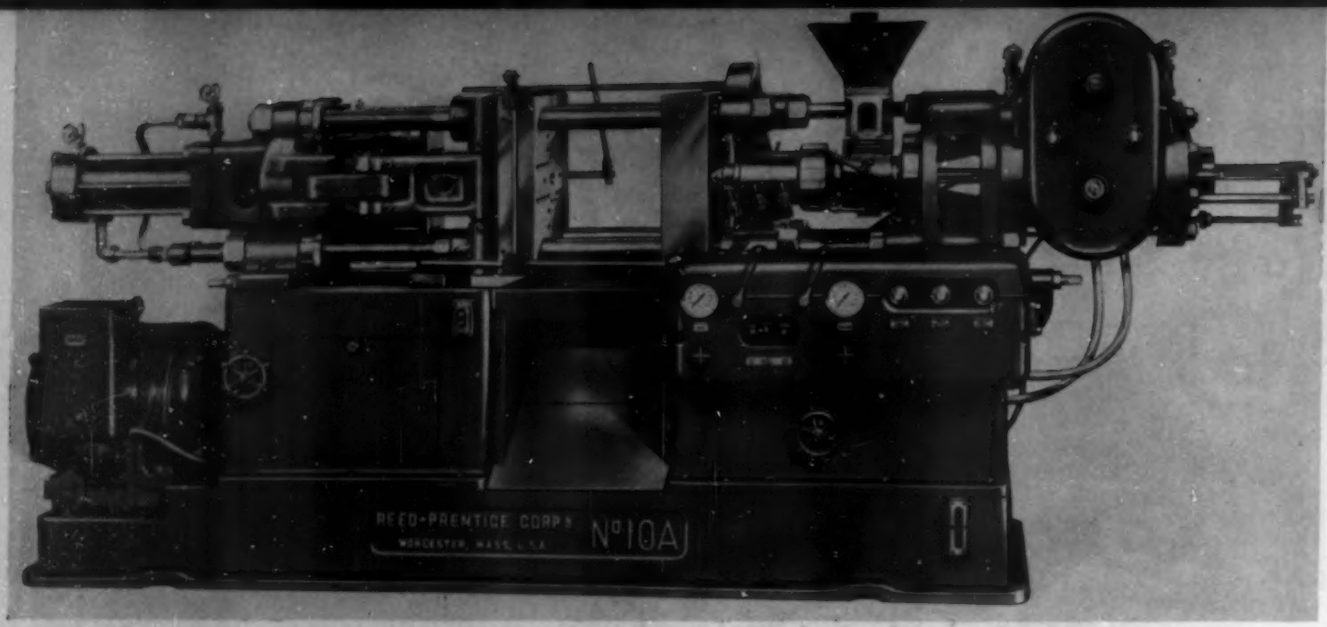

Each machine comes fully equipped. This photo depicts *standard equipment* of the Model 10A, including automatic control pyrometer.

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Stroke—7"	
Speed of plunger continuous—120" per minute	
Approximate power consumption for heating unit	0.5 to 1.5 KWH
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Die Opening	8"
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Minimum die space	6½"
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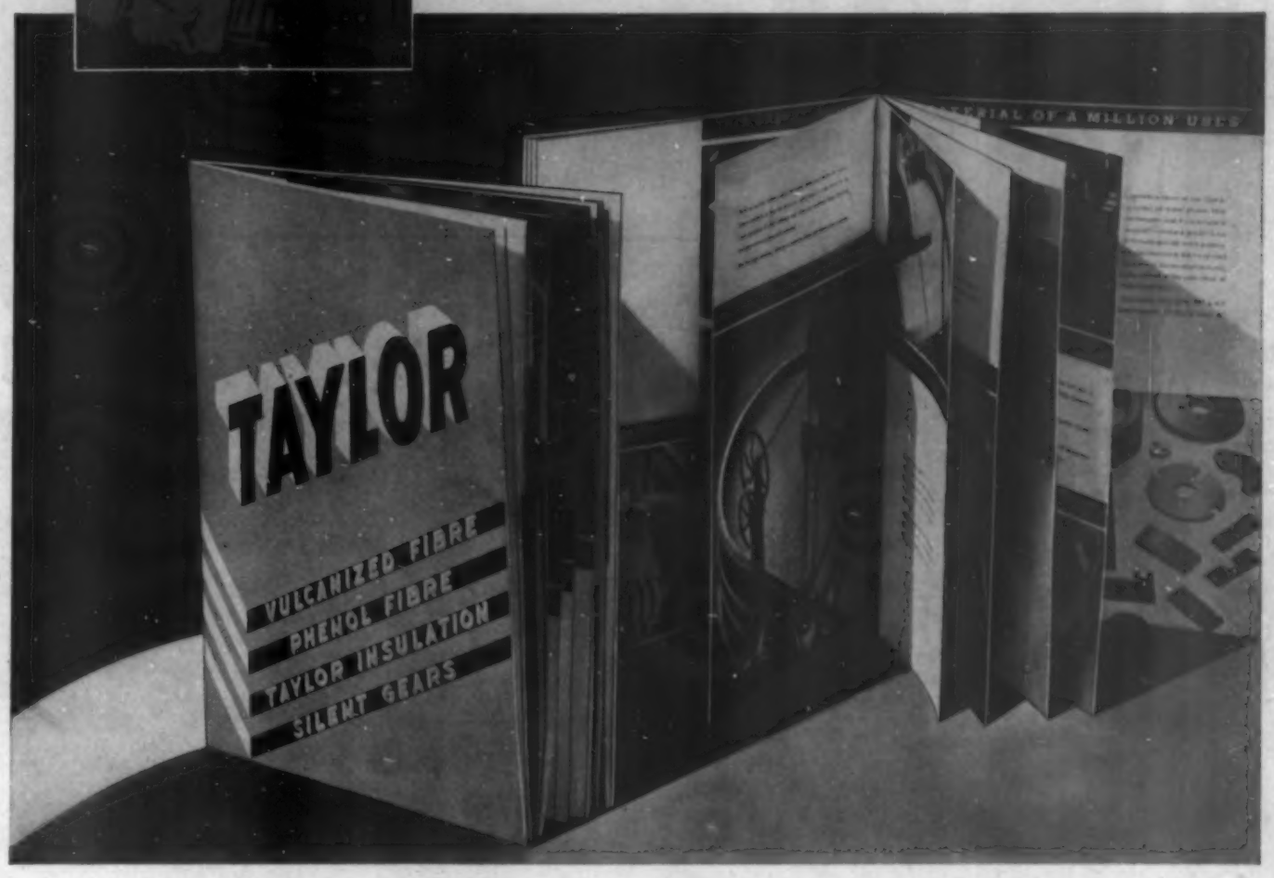

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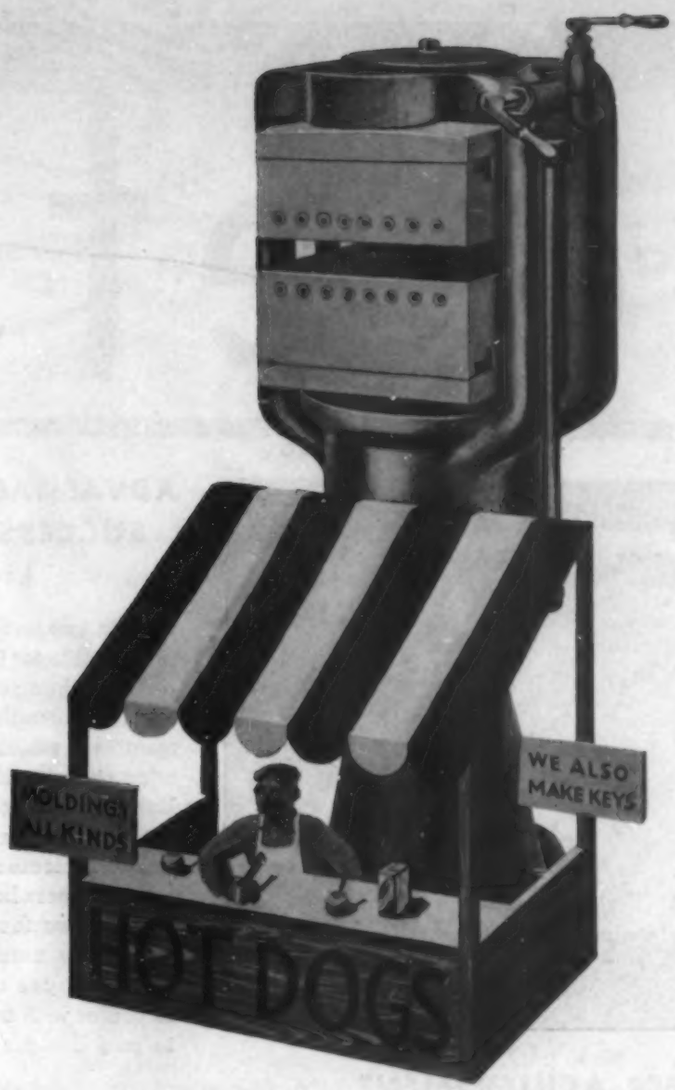

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No fooling, it's just a few years since the whole molding industry was operating on a hot dog stand basis. And every time a new shingle went up, prices went down. Like as not you'd have to pay a bit over the quotation to get delivery and keep your ambitious friend in business. But those were the grand old days . . . they certainly were!

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A PIONEER ACHIEVEMENT IN THE LIGHTING FIELD

The adaptation of plastics to modern scientific lighting is an achievement developed by Beetle* engineers. Since 1935, when the first Beetle reflector was accepted for use on the I.E.S. Study Lamp, Beetle's uses in lighting have increased rapidly, until today Beetle reflectors may be seen not only in the home but in office, factory, school, bus, automobile and railroad coach. Much of this progress is the result of research work made possible by the extensive laboratory facilities of the American Cyanamid Company, which are constantly working in cooperation with customers to adapt the uses of Beetle to new fields.

BEETLE PRODUCTS DIVISION OF AMERICAN CYANAMID COMPANY
30 ROCKEFELLER PLAZA, NEW YORK, N. Y.

*Trade-Mark of American Cyanamid Company applied to urea products manufactured by it.

it's all color and in all colors

MODERN PLASTICS
DECEMBER 1937 VOLUME 15 NUMBER 4

for better vision—BETTER LIGHT

MUCH HAS BEEN WRITTEN AND SPOKEN ON lighting fixtures in recent months and plastic materials of one kind or another have come in for a large share of this discussion. That they have their place in the manufacture of lighting fixtures there is no doubt, but their successful and satisfactory use can be based only upon an understanding of the fact that they are neither like the metal, glass nor porcelain they sometimes replace. This understanding must be shared by the manufacturer and his designer who decide they would like to employ plastics in the lighting equipment they make in order to obtain its more or less well-known advantages.

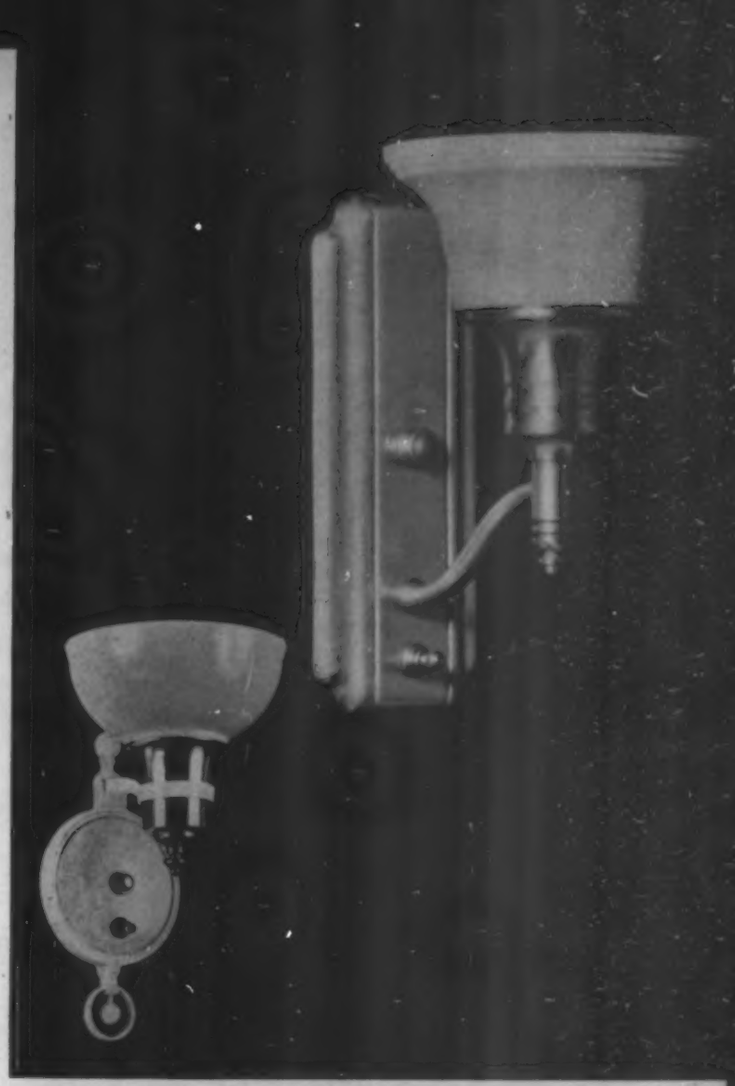
This entire lighting business which includes the specification of proper fixtures as well as the manufacturing and marketing of acceptable equipment, is one that is receiving marked attention because of the country-wide effort to preserve and aid eyesight and at the same time to provide lighting fixtures that complement rather than detract from the general scheme of interior decoration.

While speaking of the development of lighting in interior decoration at the National Lighting Conference, sponsored by Interior Design and Decoration, held in June of this year, Dr. Mathew Luckiesh, Director of Research, Nela Park, said among other things: "Modern civilization was born in the primitive cave or hut which provided greater safety and comfort than outdoors. Thus the construction of the artificial world began. Enough light was admitted at least to barely see to perform the primitive tasks. Thus windows and near-vision tasks began to replace the abundance of light and the distant-

Micarta shade used on the Midway of the Chicago Century of Progress during 1933–34

vision tasks outdoors. The possible penalties of these great fundamental changes in seeing and in seeing conditions were hidden in that vast realm of the unobvious. The practices persisted and even became more severe. Now nearly every civilized person spends considerable time daily in the performance of close visual work under an illumination a thousandth of that outdoors in the daytime. Here measurements must enter, for they are without exception the basis of incontestable knowledge. Outdoors in the sunlight throughout many hours of the day the illumination is commonly 5,000 to 10,000 foot-candles. In the shade of a tree or building it may be 1,000 foot-candles. At a window sill indoors it is commonly 100 foot-candles. However, in the interiors where people live and work it is very generally only a few foot-candles in the daytime as well as at night. No one can adequately view the powerful influence of natural environment upon the evolution of life without suspecting that modern civilization is paying penalties for such an arbitrary change in seeing tasks and conditions.

"The science of vision which deals chiefly with the eyes and visual sense contributed little or nothing toward a search for these hidden penalties. Eyesight specialists corrected certain eye defects with glasses and turned the patient back to the half-seeing world. Studies of vision deal with thresholds or barely seeing; that is, with such determinations as the smallest size that can be seen or the least amount of light necessary to barely see to perform a given visual task. The science of seeing was born chiefly in the belief that human eyes and human beings are adapted for Nature's light and lighting. New concepts were developed. Seeing was assumed to be work requiring human energy and done by muscles, nerves, organs, body and mind. We theorized in this manner many years ago and the results of our researches have adequately established the validity of these new concepts. In general, we introduce in place of barely seeing, such new objectives as certainty of seeing and particularly easy or easiest seeing. The result has been to reveal requirements of light and lighting which the interior designer must now recognize or be definitely remiss in service to human beings. The science of seeing and its pro-



Opposite page, upper left, is a hanging fixture with urea shade designed by George Ainsworth. Upper right—Chase Brass and Copper Co. chandelier with urea shades. Below at left is the new Steele-Johnson table lamp with urea shade. Lower right is the conventional student lamp with urea reflector bowl approved by the I.E.S. Made by Artistic Lamp Co. At the right on this page are two examples of home lighting units for both wall and ceiling attachment in which urea plastics are employed as reflector material. (All urea shades illustrated in this article are made either of Plaskon or Beetle.)

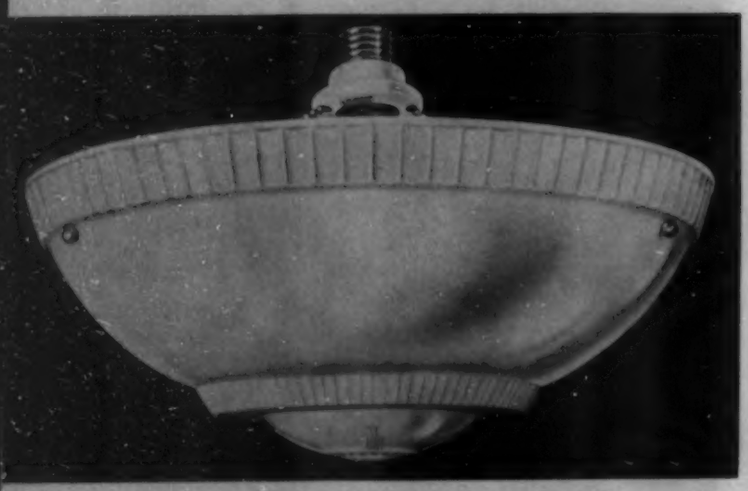
geny have swept around the world with the result that a lighting consciousness is being awakened and a tide of demand for more light and better lighting is rapidly rising."

There is little need to recall each stage of the development of artificial lighting which began with a feeble flickering wick in a pot of oil, transcending gradually through candles, coal oil lamps, gas—first in an open flame, then in a Welsbach burner—to electricity which is the world's greatest medium of artificial light; but these are worth recalling if for no other reason than to indicate that considerable progress has been made, and will be made, in the control of light and lighting to bring its greatest benefits to the individual task at hand.

Even as nature provides shade from the tremendously powerful light of the sun, so man in his development of artificial lighting has found it necessary to provide a means of distributing artificial light and diffusing it in order that it may be enjoyed in the greatest degree of comfort and decoration.

ALONG WITH THIS CHANGE IN ARTIFICIAL ILlumination and its development and control, there has been a parallel development in synthetic materials which are conspicuous in the appropriate ways in which they have tied in with this work. Since it has been proved by actual tests and usage that various plastics are equal and in some instances superior to contemporary materials for light transmission, diffusion, reflection and strength, they have a definite contribution to make toward improved lighting conditions. And what is more, their light weight, economical fabrication and adaptability to decoration recommend them to interior designers, architects and manufacturers who aim at the best possible lighting fixtures in the decorative scheme of an interior and for the greatest comfort of those who live and work within the influence of this artificial illumination.

Below—Four occasional lamps molded by General Electric Co. At bottom—12 in. indirect urea reflector furnished with screw plug to fit any lighting receptacle. Molded by Waterbury Button Co.



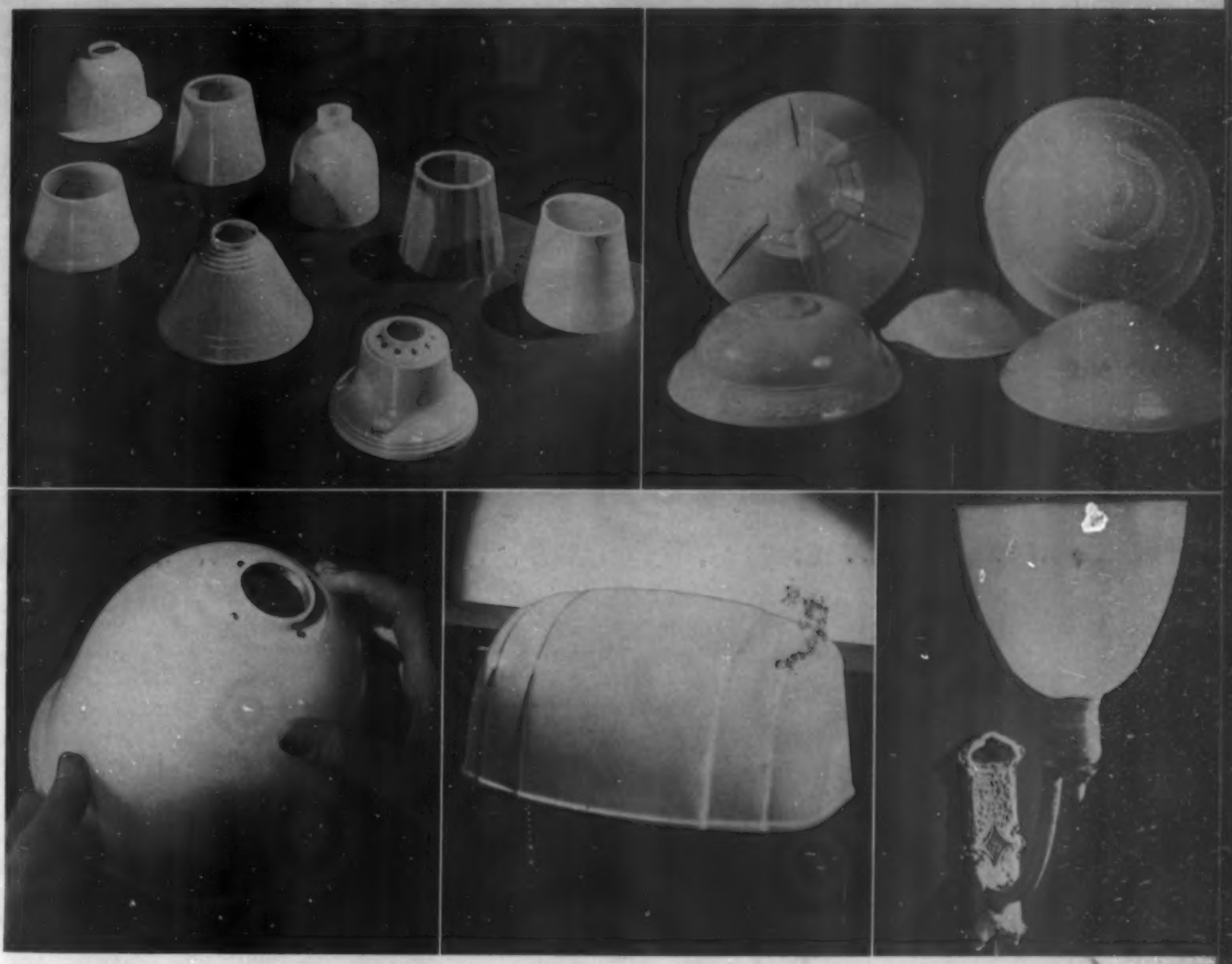
The subject of plastics and their application in artificial lighting is broad, indeed. Too broad, in fact, to cover with any intricate details in an article of this sort. Yet the proper use of plastic material for any lighting application is of such importance that we shall illustrate some of the lighting fixtures that have been made and used successfully over a period of years and which are increasing momentarily in popularity.

The first thing to be remembered about plastics is that they are of organic composition, each type with its advantages and limitations, but all capable of intelligent employment in this movement to provide better lighting arrangements in private and public buildings, as well as in the home. The next thing to remember is that they have been, and are being used with unquestioned satisfaction. And that the advantages claimed for them by their manufacturers have become established facts. Molded urea plastics,[1] which have been generally accepted as reflector material, share the chemical origin of all plastics and their composition should be understood by those using them in any way. The only alternative is to place their selection and design with competent engineers who possess that knowledge. Lighting fixtures of urea plastics depend upon careful and thorough engineering skill for their successful performance.

Urea resins in their original stage of manufacture are clear and water white, used largely for impregnating, coating and finishing. Molding compounds[2] are made by adding highly refined alpha cellulose and, when needed, pigments are included to give a broad range of soft or brilliant colors varying as desired from translucent to opaque. For lighting purposes pigments are sparingly used to avoid diminishing the light transmission of which these resins are capable.

These molding resins are thermosetting—which means that when they are shaped in a mold by the application of sufficient heat and pressure to form them, they become hardened into an insoluble mass which cannot be reshaped by heat. In this respect they are not unlike phenolic resins, but their principal advantage is that they are available in light colors which remain unchanged in use. Without pigment, urea molding compounds are pearl gray, translucent and possess remarkable qualities of light transmission and high diffusion.

MOLDED UREA DOES NOT SOFTEN UPON HEATing but because of its chemical composition it can be



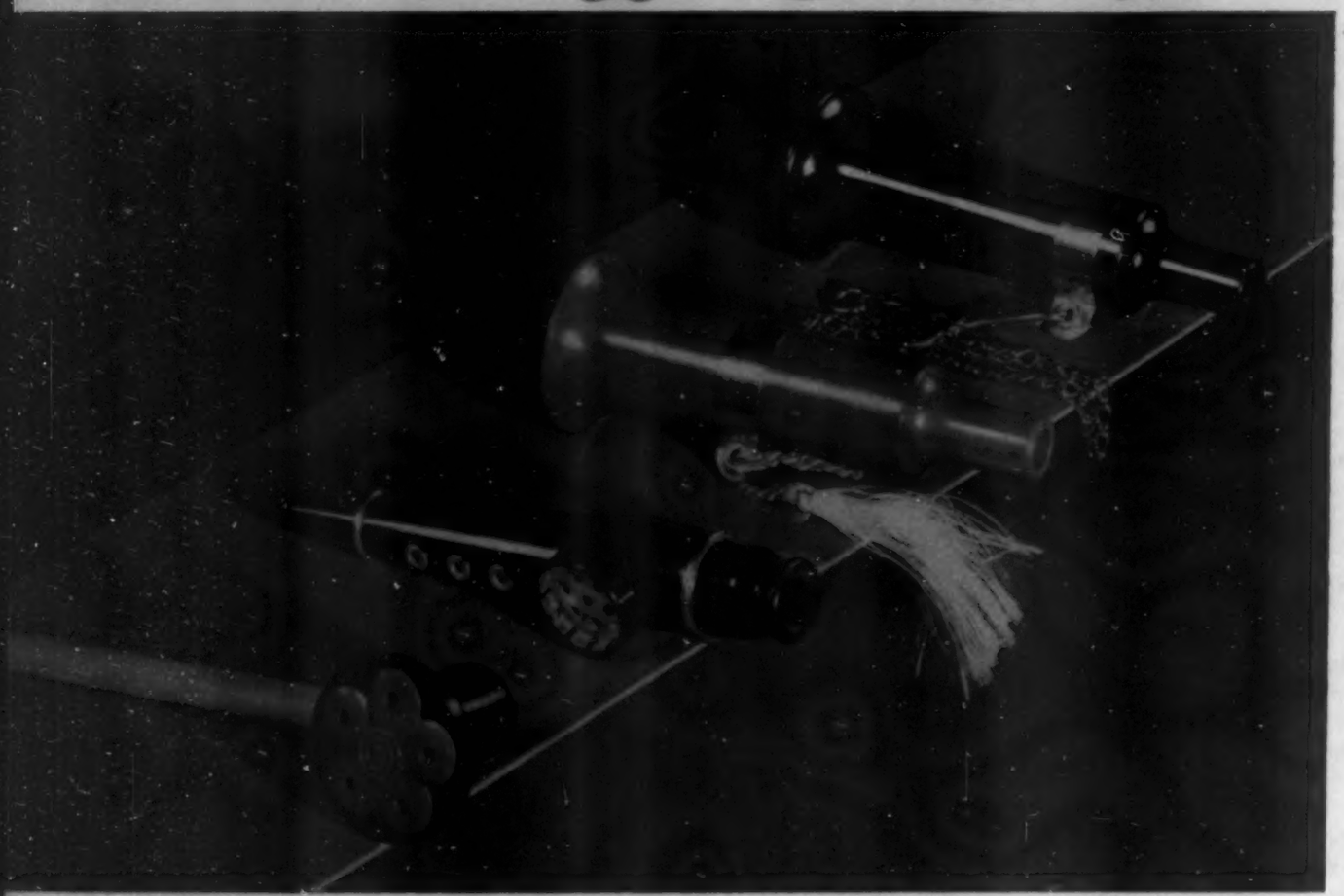
Upper left and right illustrate some of the translucent urea diffusors, reflectors and shades available in sizes from 3 in. to 26 in. in diameter. Below at left is a reflector showing the metal attachment riveted in. Center—Portable direct lighting unit with urea shade. At right—Another wall bracket type of fixture with urea plastic diffusor

discolored and eventually charred by overheating. Temperature of the lighting element, therefore, must be controlled if translucence and diffusion are to be maintained. Continuous exposure to overheating has a tendency to cause opacification which will naturally decrease the light transmission of the fixture and increase reflection. If proper attention is given to space relationship between lamp position, wattage, and size and shape of reflector, these damaging conditions may be avoided. Much data has appeared in contemporary journals and in privately printed brochures to indicate the regulations required to obtain maximum results under varying circumstances but they reveal such differences of opinion that their inclusion here might lead to confusion. The reason for this lies in the circumstances of the various tests rather than in any great variance in the urea materials available for reflector construction.

WITH THE INCEPTION OF INDIRECT AND SEMI-indirect lighting for commercial and non-commercial purposes, the demand for light-weight reflector bowls of all sizes has been enormous. These bowls may be molded in a wide variety of colors but the most popular as well as the most efficient are light ivories and white. They are designed to give a preponderance of reflected light, but at the same time to have a sufficient downward component to eliminate any shadow effects from the diffusor itself. The control of colors and the control of dimensions possible in plastic reflectors give them distinction not found in other contemporary materials.

IT IS PERFECTLY OBVIOUS THAT NO SET OF rules will govern the procedure of all future design of urea or other plastics in lighting applications. It is equally obvious that new (*Please turn to page 62*)

TOYS



1

CHRISTMAS IS THE TIME OF YEAR WHEN EVERY-one indulges in the age-old spirit of giving. When in almost every home there are brilliantly lighted Christmas trees, colored wreaths and gaily wrapped gifts. Christmas morning children will troop happily to the tree to see what toys Santa has brought them. Store windows are filled with novel things today which interest and intrigue youngsters and oldsters alike.

The most casual observer will notice that plastics are being used more and more in the manufacture of toys because in one form or another they have overcome the limitations and deficiencies of materials previously used. For example, the Lionel Corp., which has won world-wide fame for its mechanical and electrical trains, has found that the colored glass formerly used for running lights on the front of its toy engine could be replaced with advantage by a cellulose acetate material. This little light which is hardly a quarter of an inch long required a comparatively long stem in order to cement it in place, and this had a tendency to kill the translucence of the glass. It was found that by using cellulose acetate, which could be injection molded with economy, that a comparatively short stem riveted in place gave a better light at less cost. The danger of breakage was entirely removed. This cellulose acetate material has sufficient translucency for the part, and is available in a great many delicate colors as well as the red and green used.

Headlights and other parts of the Lionel trains are being molded of acetate. There are eighteen parts being used in the electric locomotive at the present time. This company is also considering the actual molding of all its trains for lighter weight, better insulation and a more permanent finish which cannot be dented or chipped.

Since plastics themselves are natural insulation, they have become indispensable for certain parts of electric trains and the track equipment used with them. While

every precaution is naturally taken in the manufacture of these parts and equipment, there has always been a recognized danger of an electric shock at the intersections of the track, and so molded plastics were used for the third rail connector shoe which cannot now be grounded and any possibility of an electric shock is absorbed. Bases and other parts of track switching equipment as well as semiphores are utilizing plastics so far as they are practical in place of metal and glass.

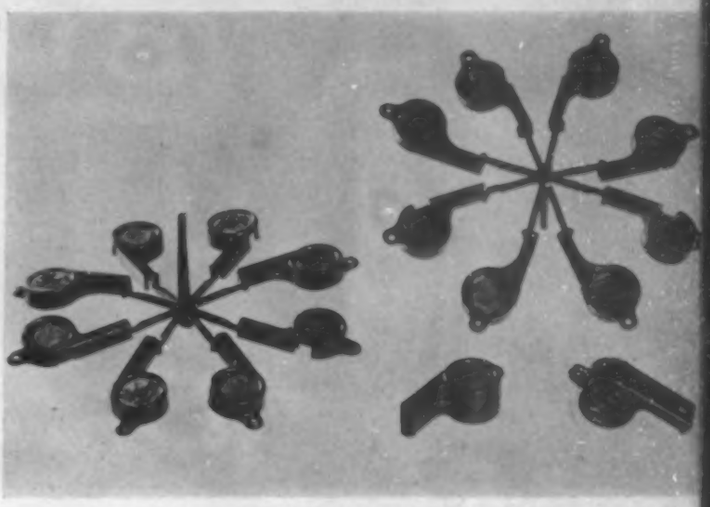
Whistles, horns, pipes, kazoos and other mouth toys made of plastics have the advantage of a smooth, hard surface that will not harbor germs and which can be easily washed and cleaned. Colors of every degree of brilliance which attract children are an integral part of molded plastics and cannot wear off. Plastic toys are entirely void of odor or taste. Another advantage which applies to all plastics is that such toys do not rust or corrode when they get wet. And nowadays practically all the plastics used for such purposes are non-inflammable, or of the slow burning type which presents no element of danger in playthings.

The Kilgore Mfg. Co. has recently brought out a line of injection molded acetate toys which have the advantage of light weight and resistance to rough handling which they are likely to get. Airplanes, trucks, fire engines, buses, police cars and taxis are made in perfect miniature and equipped with wheels of molded plastics or rubber which allow them to be moved about easily and without noise. They are resilient and will stand a lot of abuse and should they become broken they will not have sharp edges to scratch tender hands.

There are literally thousands of toys being produced from plastic materials and there are probably uncounted thousands of ways in which they will be increased in the next few years. This is indicated by the doll's bathroom washstand and bathtub made (*Please turn to page 66*)

2

3



4

1. Scotty Toys molded of Bakelite for Lewis & Scott Mfg. Co. and distributed through the George Borgfeldt Corp. 2. Doll house furniture molded of Plaskon for Herman Barr. 3. Juvenile police whistles are injection molded of Tenite in two parts by the Northern Industrial Chemical Co. for Lewis & Scott Mfg. Co. 4. Barnyard animals and floating toys of pyroxylin made by E. I. du Pont de Nemours & Co. Inc. 5. Miniature buses, engines, taxis, airplanes are injection molded of Lumarith by Kilgore Mfg. Co. 6. A few of the plastic parts used on Lionel trains. Molded by Boonton Molding Co. and Shaw Insulator Company. In the foreground are running lights of acetate and a cast resin lantern. Third rail connector shoes are shown at the rear

6

5

DESIGNED FOR MOLDING

IT IS NOT OFTEN WE HAVE AN OPPORTUNITY to present such pleasing design in molded plastics nor does it matter particularly that this job was not molded in the United States. The point is that plastics are versatile materials, lending themselves to functional and decorative manipulation which, in intelligent and experienced hands, results in good design.

This Purma Special, a candid camera designed by Raymond Loewy, well-known American designer, has an all molded phenolic case with lens cap and film winder of the same material. It is a product of Purma Cameras, Ltd., London.

The outward or visual appearance needs no commendation. Its attractive lines and simplified mechanism indicate at a glance that it is easy to look at and simple to use. It is only after a better acquaintance with the completeness of the design that you can appreciate the engineering study and thought which make that simplicity possible.

To begin with, when the cap is removed the anastigmatic lens with 6.3 aperture automatically extends to the proper position to give universal focus from 12 feet to infinity. There is an all-metal focal-plane shutter equipped with an automatic speed adjustment so that slow, medium, and fast exposures can be made without other adjustment than holding the camera in the proper position for the speed desired. The size of the camera is only $6^{3}/_{4}$ in. by $2^{1}/_{4}$ in. by $2^{3}/_{4}$ in.; weight 12 oz.; price about $12.00 in England.

All parts are molded with a special formula of phenolic compound which is non-radioactive, light proof, dust and damp proof. Reciprocal threads in the cap and on the case are molded in. When the cap is in place all mechanism is locked and the lens recedes into the camera where it cannot become damaged or be in the way. The shutter release is recessed in the top of the case in a convenient and natural place to use.

ARCHITECTURE IN A MECHANIZED WORLD

by JOSEPH HUDNUT*

THE CENTRAL PROBLEM IN ARCHITECTURE AT this moment is that of its relation to modern industry. If, indeed, architecture can exist in a mechanized world, it must obviously adjust its processes to those which will prevail in that evolving pattern; and that adjustment will affect profoundly our professional attitudes and techniques, our educational methods and the quality of our art. It seems highly probable, for example, that the activities of architects will be more closely co-ordinated with those of engineers; that the approach to both professions will be through scientific study rather than through the study of art; and the nature and intentions of architectural design will be recognized as having an essential unity with all other processes by which materials are assembled and shaped for human use.

If architecture thus approaches industry, attempting a more realistic basis for its themes, harmonizing its rhythms with those of a contemporary technology, industry will also approach architecture, subjecting its functional forms, in the processes of manufacture, to that subjective guidance which too often has been the almost exclusive concern of the architect. Both architect and industrial designer will be concerned not only with purpose, convenience and stability but also with attributes of form beyond those demanded by utility. Both, to be accounted successful, will possess that ability—which Freud calls mysterious—of so molding a material and objective substance as to give it qualities which, although apparently unrelated to its origins and purposes, are yet universally valued for the order and grace which they bring into human life.

If, then, there shall remain differences between architecture and industrial design, these differences will not be inherent in the essential nature of their objectives. They must arise, rather, from the opportunities afforded by differences in subject matter: from opportunities which in the one case make possible a greater range or depth to those processes by which objects attain an emotional or spiritual power. If there shall remain in a machine age qualities of expressiveness possible to buildings and not to airplanes and locomotives, to textiles and glass, it may be that these will be the consequence, not so much of differences in techniques—since both will be products of industry—as of differences in those processes which by their nature transcend technique.

If the reader will grant that that is and may be possible, I should like to describe briefly some of these differences and sketch some of the varying boundaries which I believe will afford the designers of buildings peculiar opportunities of expressiveness.

Of these opportunities, the most obvious will be:

(a) A command of enclosed space, possible to buildings and not to other products of industry;

(b) A relationship, more intimate and sustained, to our way of life;

(c) A part, more fundamental and more prescriptive, in the pattern of communities.

These opportunities, if not neglected by the architect, will endow his work in the future, as in the past, with qualities distinct from those of all other products.

I. Space as a material of architecture

The persistence with which architects have clung to the classic patterns may be in part accounted for by their feeling that such patterns embody universal values inaccessible to modern technological forms; and if it is by no means certain that these values can be recaptured by imitation it is at least certain that they are prohibited by an uncompromising functionalism. In neo-classic buildings the essential resources of architecture have not been, it is felt, sacrificed, even though they are embodied in a somewhat equivocal form.

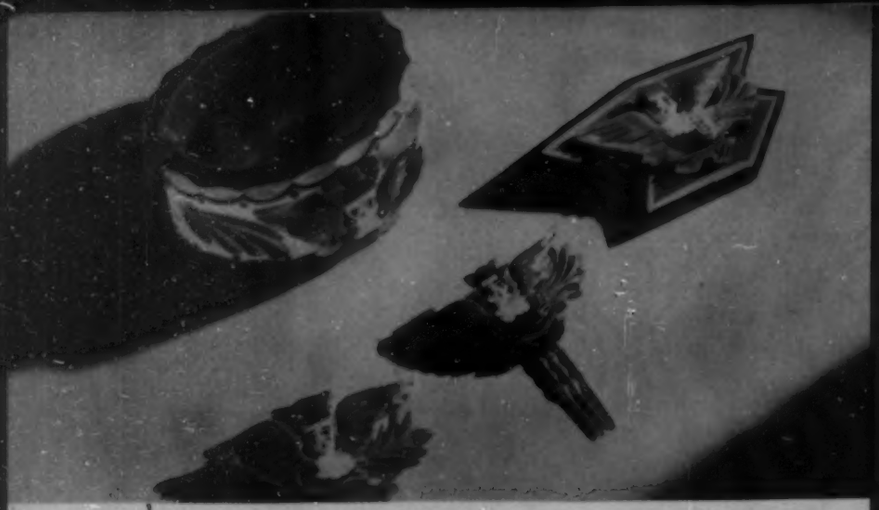
Among these resources, the most obvious are, first, a sense of weight or of mass and, second, an ordered and balanced composition made evident and harmonious by an insistence upon the primary geometrical shapes.

Le Corbusier, who with all his vehemence does not always escape the neo-classic ideology, tells us that the primary forms are essential to beauty—without explaining how they are possible to the products of a machine technique. I do not believe that they will be possible to such products. Streamlining, besides its publicity and sales promotion value, is undoubtedly a useful resource in the design of airplanes, locomotives and buildings, but it will not restore to architecture the cube, the cylinder or the sphere. Nor will symmetry, except in rare instances, remain a serviceable expedient. The buildings of our new age will assume an outward aspect of complex geometric form, not unlike the Baroque, and yet without Baroque fluidity or any evidence of that formal principle which gave unity to its energetic rhythms.

To an even lesser degree will these buildings admit weight and mass as expressive qualities in their design. Weight and mass are indeed possible to machines; but these qualities in machines are wedded to a dynamic energy rare in buildings—(*Please turn to page 68*)

* Dean, Graduate School of Design, Harvard University.

IN REVIEW



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1. Gamayun charm jewelry of Catalin introduced by members of the Ballet Russe de Monte Carlo. The colorful bracelets, brooches, clips and barrettes are typically Russian and were inspired by a number of the members of the ballet

2. Private bar designed by William Lescaze. Bottles, glasses and tray are resting on white Formica whose inert surface has proved practical as well as decorative

3. An extra heavy phenolic molding material with five times the usual impact strength is used on the Weber Lifelike Fly Co.'s fishing reel. Plastics are used here because they do not corrode. Molded of Durez by Eclipse Moulded Products Co.

4. Catalin display which reproduces the actual Kitstick molded by Colt's Patent Fire Arms Co. of Plaskon. A giant reproduction is also fabricated of Catalin and used independently of any background

5. The Enders Speed Razor manufactured by the Durham Duplex Razor Co. has a Bakelite handle curved to fit the hand. The razor head lies against the face at the proper angle for a clean, smooth shave. Molded by the Scott Mfg. Co.

6. This ensemble of Crystallite comb and brushes, available in a wide variety of colors, is packaged in a transparent Lumarith box for better display. Designed by Lee Albertson, these sets make attractive gifts

7. Stewart R. Browne Mfg. Co., Inc., has designed a new type flashlight which is constructed for use under water for indefinite periods of time. The case which is molded of Bakelite will not corrode and a sealed switch enclosed in a rotating knob controls both light connection and focusing mechanism

8. Taylor Instrument Co.'s Hampton Humidiguide is molded of Durez by the Diemolding Corp.

9. A cigaret lighter called "Baronet," designed by G. M. Haynie, is produced by L. F. Mefker Co. and molded of Plaskon by Reynolds Spring Co. This comes in either red or ivory in combination with a chromium base and braces

10. Transducer Company's bullet microphone is now being molded of Beetle in light shades by the Accurate Molding Company as well as in the darker shades of Bakelite

11. Barrettes injection molded six at a time by Kingman Company for Ben Hur Products. The photo shows the jewelry as it comes from the mold, after which it is broken off the sprues and assembled

12. Kem playing cards are now packed in a gift box of molded Lucite, a new transparent plastic material which permits the design of the cards to show through in a pleasing pattern

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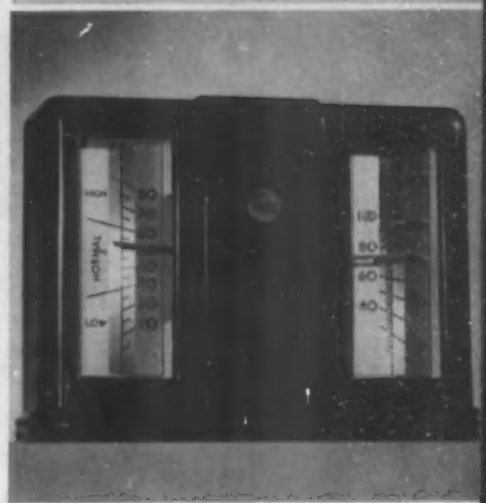

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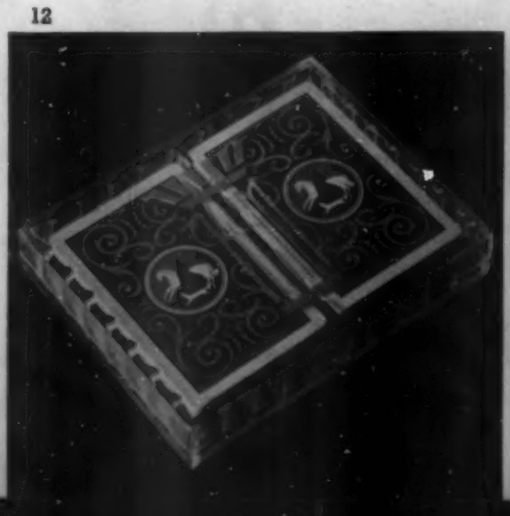

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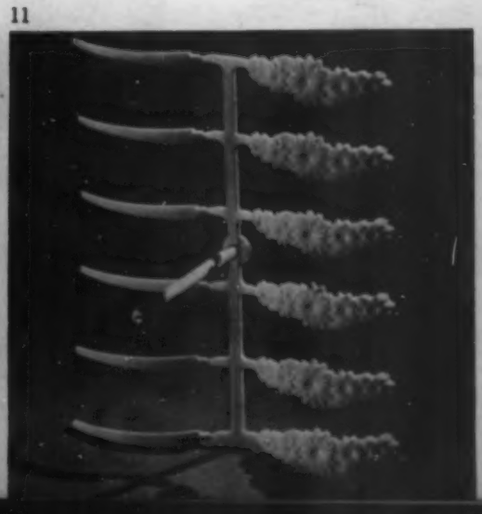

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PLASKON

MOLDED COLOR

BARONET LIGHTER

The Geo. L. Mesker Company is getting front space on Christmas counters with this appealing Plaskon lighter. Current sales are heavy and before Santa Claus arrives, the company expects point-of-sale display to move a maximum number of the lighters.

All this must be a source of satisfaction to G. M. Haynie who designed the "Baronet." Mr. Haynie chose Plaskon chiefly for its selling appeal and durability and because it was so economically practical for his modern metal and plastic design.

If you'd like to know how Plaskon can help put your product "up in front," we'll be glad to send complete information and case histories pertinent to your own situation.

The "Baronet" cases (in green, ivory, or red) are molded by Reynolds Molded Plastics.

DALYNIP POURER

One of those small but mighty developments which have far reaching effects on life is the Dalynip Pourer. It replaces cork or cap on an opened liquor bottle. Bar tenders have taken it up enthusiastically because (1) it eliminates spilling; (2) it pours neatly an exact drink into a small glass; (3) it saves all the time of taking off and replacing the bottle's usual cap; (4) it is very sanitary with its nickel-plated copper tube and its little flap which closes when the bottle is upright.

You'll see the Dalynip Pourer at bars throughout the country from now on, until at length it will be as normal a part of a bottle as the label or the neck.

Dalynip is molded in Plaskon by Universal Plastics—for the Dalynip Pourer Corporation of N.Y.

CHRISTMAS • 1937

MAJESTIC RADIO

Upon receiving the beautiful five-tube super-heterodyne Majestic you see at the bottom of this column, we immediately asked Designer J. O. Reinecke for a few words about it. His reply will, we think, interest sales-minded people.

"A white Plaskon case was chosen for the Majestic table model because it is proof against marring, straining, and chipping, while the fine smooth texture is warm and pleasant to the touch . . . The inherent attractiveness of Plaskon along with its durability, make it one of the designers' greatest aids in the achievement of eye-appeal."

This highly successful radio is made by Majestic Radio and Television Company, for whom Chicago Molded Products Corp. does the molding.

ELECTRIC SHAVER MIRROR

An electric shaver mirror which can be plugged in any electric socket to provide the right light for a good, clean shave, is a recent offering of the Acme Specialty Mfg. Company. A notable feature of the clever design is a lustrous, peel-proof Molded Color base for storing razor and accessories. When the mirror is not being used, a cover, made of Plaskon, conceals the shaving implements from view.

Lanfare Molded Products of Toledo, Ohio fabricate both molded pieces for the Acme mirror, which is one of the too few combinations of metals, plastics and plate glass.

Merry Christmas!

PLASKON COMPANY
INCORPORATED
2121 SYLVAN AVENUE, TOLEDO, OHIO
CANADIAN AGENT: CANADIAN INDUSTRIES LIMITED, MONTREAL, P.Q.

PRESENTATION DINNER

ON THE EVENING OF NOVEMBER SEVENTEEN, A reception and dinner was given in the Grand Ball Room of the Hotel New Yorker, New York City, to honor those whose entries won awards in the Second Modern Plastics Competition. More than two hundred of the quests invited, attended.

Immediately following the dinner, C. A. Breskin, publisher, welcomed the guests. E. F. Lougee, editor, introduced the speakers and presented the awards.

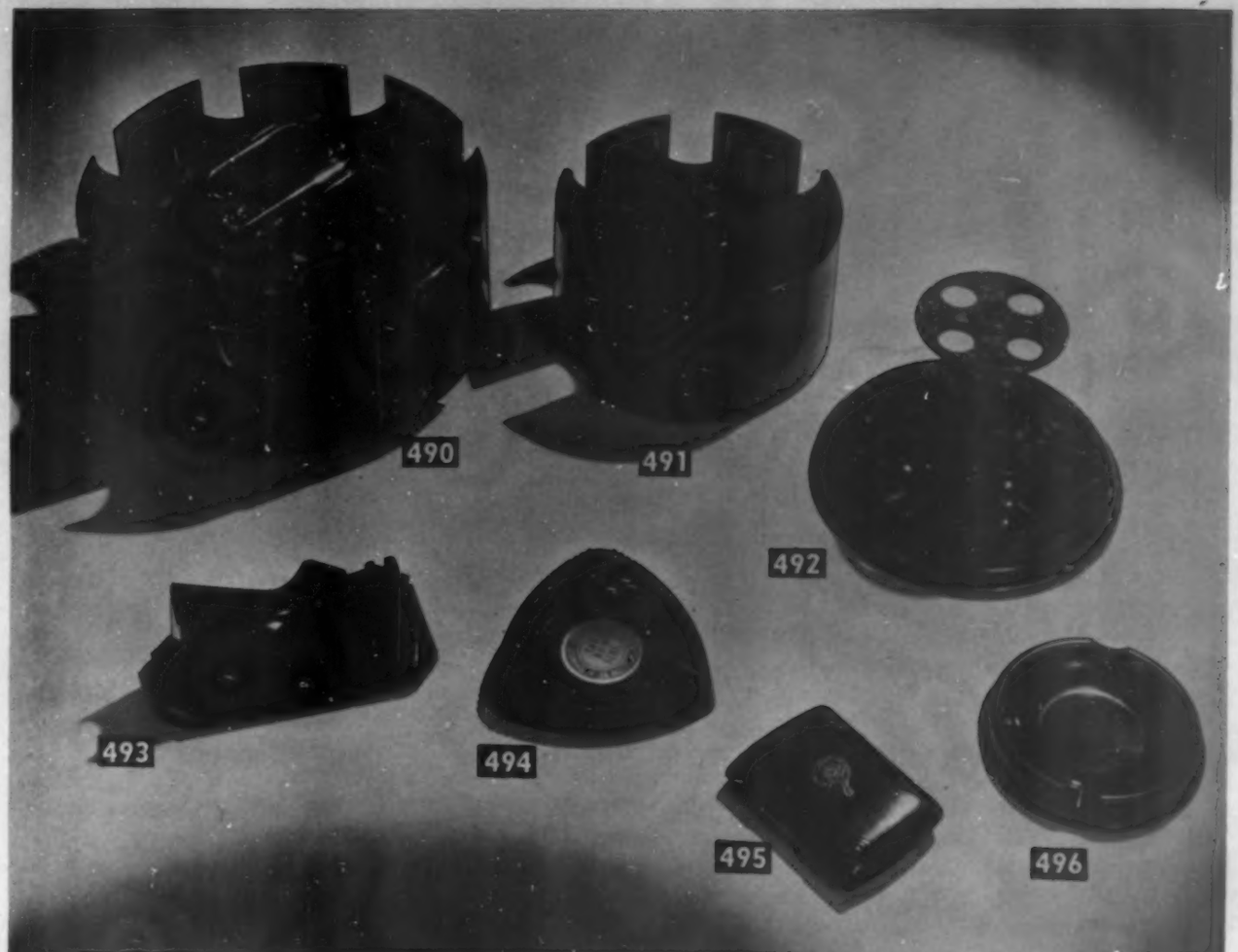
Harvey Wiley Corbett, authority on architecture and design who has served as one of the Board of Judges in both the First and Second Competitions, spoke for the judges and envisioned a lively future for plastics because of their versatility as functional materials combined with flexibility well suited to modern forms. He pointed out that there has been real progress in the appreciation of these materials by designers during the past year as evidenced by the entries in the present Competition.

Among those seated at the "Winners' Tables" were:

G. W. Brown, Bankers Protection Co., Simsbury, Conn.; Andrew F. Haiduck, Bellanca Aircraft Corp., Newcastle, Delaware; P. J. Howe, Western Union Telegraph Co., New York; Earl Douglas, Studebaker Motor Co., South Bend, Ind.; Wm. H. Gref, E. H. Hotchkiss Co., Norwalk, Conn.; C. A. Verschoor, International Radio Corp., Ann Arbor, Mich.; C. K. Castaing, Stony Brook, Long Island; Louise Sanders, Louisesanders, New York; Charles W. Darr, Harriet Hubbard Ayer, Inc., New York; A. Shields, Shields, Inc., Attleboro, Mass.; H. Earl Hoover, The Hoover Co., North Canton, Ohio; Walter von Nessen, Chase Brass & Copper Co., Waterbury, Conn.; Walter A. Morris, Steelsmiths, Inc., Meriden, Conn.; J. W. Baum, Sonotone Corporation, Elmsford, New York; Geo. C. Knott, McGill Mfg. Co., Valparaiso, Ind.; J. S. McDaniel, Cadillac Motor Car Division of General Motors Corp., Detroit, Mich.; E. E. Evelyn, Gregory Ink Co., Los Angeles, Calif.; J. E. Alcott, Hurst, Inc., Boston, Mass.; Milton Jacobs, D. Lisner & Co., New York; William Wilder, William Wilder, Inc., New York; J. R. Morgan, Sears Roebuck & Co., Chicago, Ill.; C. L. Searight, Aluminum Cooking Utensil Co., New Kensington, Pa.; and E. E. Levings, Imperial Brass Mfg. Co., Chicago, Ill.

Following the presentation of awards, the gathering was addressed by General Smedley D. Butler, the principal speaker of the evening, who chose his favorite topic "War" which he presented in many facets of pathos, ridicule and derision. General Butler, retired, was for many years in command of the U. S. Marines.

A plastic bound souvenir program illustrated and described the Winning Awards and Honorable Mentions and eighty-nine molded plastic plaques were presented to those companies, designers and engineers whose product or services entered in any way into the production of the entries which won awards.



STOCK MOLDS

SHEET FORTY-FIVE

Utility gifts for men are available from stock molds. Interested executives should write on company letterhead specifying both sheet and item number

---

490. Eight-section revolving chip rack, 8 in. in diameter on a molded base. 3 3/16 in. high with openings for two decks of cards. A collapsible metal handle permits an easy grip

491. Chip rack 5 3/4 in. in diameter with four sections 3 3/16 in. high. Holds one pack of cards. Base does not revolve but a molded knob permits easy turning

492. Pipe rack 4 3/8 in. overall holds four pipes. Openings for stems 11/16 in. in diameter. Molded in grooves for pipe bowls.

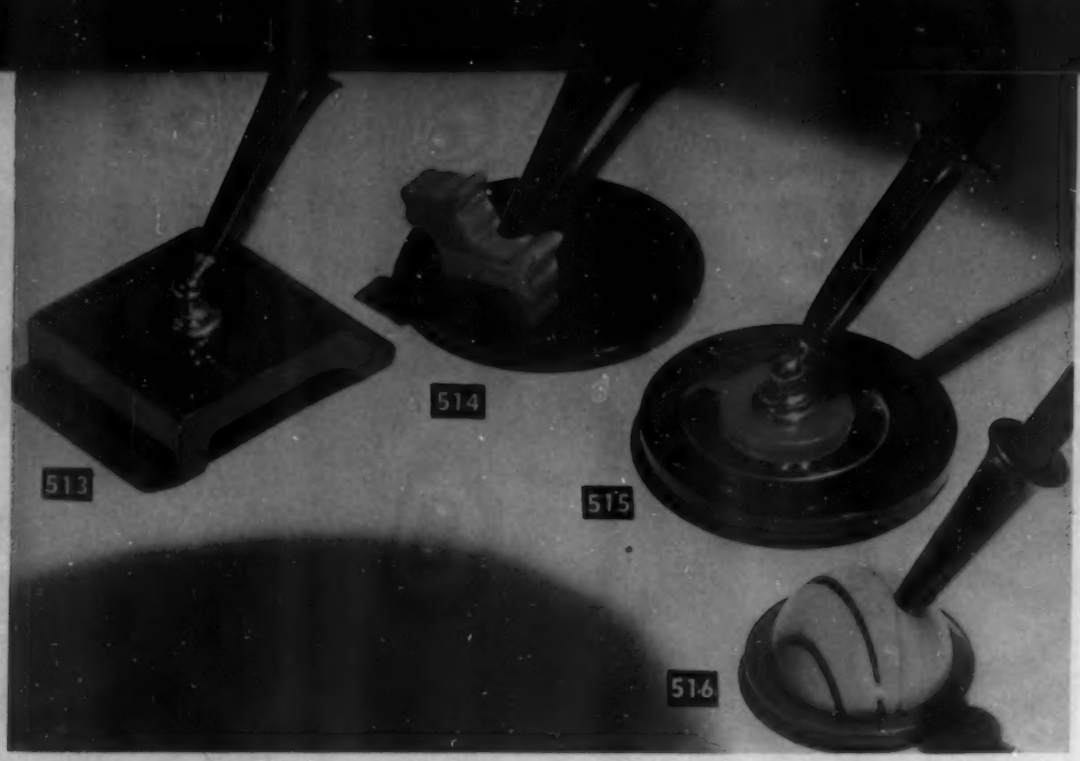
493. Pipe rack and match holder 4 3/4 in. long and 2 3/8 in. high

494. Triangular ash tray with removable metal identification plate. 3 cigaret rests

495. Cigaret case with metal inlaid design and spring clips to hold cigarets in place. 3 1/8 in. long, 2 in. wide inside

496. Round ash tray with two cigaret rests, 3 1/8 in. diameter and 5/8 in. high

Address all inquiries to Stock Mold Department, Modern Plastics, 425 Fourth Avenue, N. Y. C.
All molders are invited to send samples from stock molds to appear on this page as space permits.



STOCK MOLDS

SHEET FORTY-SIX

These cast resin pen bases are available as premium or retail items from stock designs. The bag tops illustrated below are injection molded of acetate material in stock molds. Manufacturers' names will be sent to interested executives upon request

---

513. Pen base 2 3/8 in. long and 2 3/16 in. wide. Stepped design in the front

514. Round base 3 in. in diameter. Red scotty dog supports the pen holder

515. Round base 3 in. in diameter. Two disks of cast resin separated by a disk of metal make this attractive pen stand

516. A half ball of light plastic on a 2 in. base of contrasting color supports a penholder to match the base

Four two-piece bag tops with closing clips are injection molded in jigsaw pattern. Holes for sewing to bag are already drilled and provision for attaching handle is made

517. 7 in. long; 2 in. high

518. 7 in. long; 1 3/16 in. high

519. 6 15/16 in. long; 1 1/8 in. high

520. 5 15/16 in. long; 1 1/16 in. high

Address all inquiries to Stock Mold Department, Modern Plastics, 425 Fourth Avenue, N. Y. C. All molders are invited to send samples from stock molds to appear on this page as space permits.

TECHNICAL SECTION

CHANGES IN FINISHING MATERIALS

by A. G. HOVEY*

TO A CERTAIN EXTENT, THE DEVELOPMENT of molding plastics may appear to the paint, varnish and lacquer manufacturer as a new rival which intends to take away his market. Certainly it is true that many small objects which formerly were finished are now being molded into beautifully colored designs which require no finishing. We are all aware of the fact that molding men are becoming more and more ambitious and that they expect to mold bigger and better things all the time. This, naturally, will mean less and less material to be covered by finishes unless the continued demand for lower and lower cost in molding products means that the color and appearance of the molded article will have to be so greatly sacrificed that it will require finishing anyway. It is quite likely, however, as the size and cost of the molded object increases there will be more and more tendency towards applying a finish over the molded object because this article would be too valuable to throw away just as soon as it gets dirty, slightly damaged or in need of redecorating. There are many ways in which the plastic industry needs some of the experience of the finishing industry and vice versa and it is hoped that this article will bring out a few of these needs.

Both the molding and the finishing industry, of course, are extremely old. Let us omit a detailed description of the early primitive ceramic industry which was developed in prehistoric times and stories of how the Cro-Magnon men some 12,000 years ago made certain paintings which have lasted inside of caves ever since then, and start out with the beginning of this century. At that time, house paints consisted almost entirely of oil and pigment. A certain amount of cold water paint was made from casein, water and linseed oil. A great deal of spirit varnish was used for sizing and sealing. The needs for all the various types of varnishes and enamel vehicles were supplied mainly from linseed oil, the fossil gums and rosin. From these few ingredients, the making of products which varied all the way from low-cost gloss oils and sanding furniture varnishes to high-grade coach and carriage wheel varnishes taxed the skill of the varnish-maker to the utmost, but developed it to an exceptional degree. The automobile introduced new finishing problems including the difficult dual requirement of high-speed baking and long life on metal which is to be driven over all sections of the country in all kinds of weather and under a great deal of vibration. Consequently when such new and radical finishing materials were needed they were eventually found. Just at the time certain varnish manufacturers had produced unique quick-baking long-life oleo-resinous enamel vehicles, suddenly nitrocellulose lacquer completely displaced oil varnish enamel vehicles as the finishing coat. The bottom coat, however, was still an oil-base primer to provide adhesion of the lacquer to the metal and humidity resistance to the finishing system. Automotive lacquers use large quantities of resin for the purpose of obtaining adhesion and diminishing the porosity of the nitrocellulose film. Soon after the advent of the automotive lacquer, it was found that synthetic resins, especially alkyds, had much merit in automotive lacquers, because their durability was greater, and because they were much more clean and uniform than natural resins. The alkyd resins quickly replaced a large percentage of the total amount of natural resins used in finishing automobiles. In fact, some automobile manufacturers have gone all the way and replaced all other ingredients in lacquer with alkyd resins. Such an all-synthetic enamel naturally has great durability and luster retention and is lower in cost due to the fact that cheaper solvents can be used. By replacing lacquer with alkyd resin vehicle, it has been possible to make a substantial saving in the cost per car. For the same reasons, enormous quantities of all-alkyd resin enamels are being used for exterior purposes today on such ob-

The making of a wide variety of products taxed the skill of the varnish maker to the utmost, but developed it to an exceptional degree

* Director of Research, Beck, Koller & Co., Inc.

Modified phenolic resins (above) are uniform in properties from batch to batch and free from varying amounts of dirt and impurities. (Below) Unloading a batch of reactive "concentrated phenolic resin"

jects as farm implements, license plates, street cars, buses, trimming paint for houses, etc.

Fossil resins are still used in many applications but today comparatively few varnish manufacturers are running their own gums, because it has been found economically advantageous for one resin manufacturer to import the fossil resin direct and process it so that the manufacturer can cook varnish without the necessity of "running" the gum. In this way, the varnish manufacturer can now make larger batches of varnish than formerly because the running involved excessive foaming and fire hazard, and now, with the processor treating the fossil gum in large batches, better color due to the special apparatus used and greater uniformity can be obtained because much larger batches than the varnish manufacturer would care to "run" may be processed and then blended with other large batches of processed gum. Fossil resins, on account of this, are receiving a temporary impetus, yet there is no question that fossil resins eventually will be used up because of their limited supply. It took Nature a million years or more to make fossil resins and we have been using them up at quite a rapid rate.

The modified phenolic resins were the first synthetic resins after the advent of ester gum to make inroads on fossil resins for cooking varnish. The modified phenolic resins proved to be far easier to handle in the kettle than fossil resins. They could be melted immediately without foaming and stirred in with the oils and other varnish forming ingredients without the necessity of destructive distillation, which required loss in weight of approximately one-fourth of every batch, when fossil resins were used. Modified phenolic resins are uniform in properties from batch to batch and free from varying amounts of dirt and impurities.

The next development in varnish gums was "concentrated phenolic" resin, or, those which are sometimes referred to as belonging to the "100 percent phenolic" type. These resins consist entirely of specially substituted phenols and aldehydes which impart oil solubility. When cooked with drying oils these resins yield varnishes of exceptional durability and resistance to water, and to many chemical agents. There are two types of concentrated phenolic resins; the "reactive" type and the "non-reactive" type. The reactive types are "dialcohol resins" which actually react with fatty acids, rosin and esters; consequently, in their reactivity there is inevitably a certain small loss in weight caused by the volatilization of water formed by the reactions, but this is a necessary evil which accomplishes much good. For example, who would ever think of heating naphthalene with glycerol, yet when one reacts phthalic anhydride with glycerol, a useful product is obtained.

In addition to the reaction with the carboxylic groups of fatty and resinous acids, one molecule of the phenol dialcohol, according to Hoenel[7] and Krumbhaar,[19] ties together two molecules of drying oil or of the corresponding fatty acid, the condensation taking place between the two alcoholic hydroxyl groups of the dialcohol molecule and one hydrogen atom in each of the aliphatic chains of the oil molecules, especially those hydrogen atoms which are activated by the vicinity of the double bonds. The fact that this type of linking the oils or their acids does not saturate the double bonds accounts for the remarkably good drying characteristics of varnishes made from this reactive type of the phenol-dialcohol resins with drying oils.

The "non-reactive" type does not foam nor show any loss in the kettle except for a very small amount of volatile material, and this loss is practically negligible. These resins consist of condensation products of phenols with compounds of methylene structure other than formaldehyde brought about by the influence of an acid catalyst. While these resins are called "non-reactive," they really are reactive by an addition process akin to the Diels-Alder synthesis.[19]

Door knobs and escutcheons injection-molded of Tenite by Commonwealth Plastics Company

TENITE opens doors

AFTER GENERATIONS . . . CENTURIES . . . a new material has been found for door knobs.

Makers of building hardware have discovered in the plastic, Tenite, a material even better for knobs than the traditional metal, glass, and porcelain.

Tenite door knobs do not break, dent or tarnish . . . they are lustrous, smooth, and warm to the touch . . . and, above all, they have color—color that never dulls, peels or chips.

In the Lockwood Patrician Hardware illustrated here, knobs and escutcheons of Tenite are interchangeable, enabling dealers to offer a complete range of colors without a large investment, and housewives to change decorative schemes with screwdrivers.

Tenite has opened doors to new sales opportunities in scores of industries, adding to the beauty and serviceability of products, with manufacturing economies in the bargain. Many manufacturers are finding that their products can be molded of Tenite more economically than they can be cast or machined of any other material.

Tenite is a tough, practically unbreakable plastic made of Eastman cellulose acetate, in all colors—plain, variegated, transparent, opaque. A 52-page illustrated book on Tenite and its uses will be sent you on request.

TENITE REPRESENTATIVES: New York: 10 East 40th St.; Chicago: 2264 Builders Bldg.; Detroit: 914 Stephenson Bldg.; Leominster, Mass.: 25 Merriam Ave.; Pac. Coast: W. & G. Meyer & Co., San Francisco: Federal Reserve Bldg.; Los Angeles: 2461 Hunter St.; Seattle: 710 Belmont Pl.

TENNESSEE EASTMAN CORPORATION, KINGSPORT, TENN., Subsidiary of Eastman Kodak Company

The non-reactive resins are useful for gaining complete "gasproofness" of the China wood oil and at the same time retaining relatively light color and chemical resistance in the varnish film. The heat-hardening reactive type is necessary in order to attain hardness and marproofness as well as high film strength and chemical resistance. Molding men can appreciate that the reactive type of 100 percent phenolic resin is the nearest approach in a varnish gum to the chemical inertness and rapid curing associated with the use of alcohol-soluble phenol-formaldehyde molding resin. However, in the case of the concentrated phenolic varnish resins, they differ greatly from the alcohol-soluble phenol-formaldehyde molding resins in that they are soluble in oils and in solvents not only of the coal tar aromatic type, but also in the low solvent power petroleum solvents.

(Above) Apparatus used for thinning and blending alkyd resins. (Below) A battery of stills for making phenolic resins

The only serious objection to the concentrated phenolic resins in varnish products is the same as the objection to phenolic molding compounds, that is, the color. The bane of phenolics that they yellow in the sunlight extends over into the use of the phenolic resins in the varnish field in much the same way as in the use of phenolic resins for molding compounds, although to a much less objectionable degree. The pure alkyds are most widely used where color is important.

When all factors are considered, such as volume, durability, low cost and dependability alkyd is the king of finishes today. The unusual combination of rapid drying, light color retention, durability, gloss retention, solubility in cheap solvents and versatility recommend alkyds for practically every coating purpose under the sun except where extreme resistance to such hazards as steam, strong acids and alkalies is required. Exposure to sunlight and to heat is where alkyds "shine"; they outlast all of the other commonly used finishing materials under these conditions so well that they might be said to "like it."

In the early days of alkyd resins, their water resistance was far less than it is now and the pigment compatibility was poor. In other words, they were not "foolproof." About 1927–28 phenol modified alkyd resins were introduced by Hoenel[8] which were in effect a much desired compromise in properties between the durable, glossy, quick-drying alkyd and the waterproof spar varnish which consists mainly of phenolic resin and China wood oil. Thus a "foolproof" finishing material was made available which found immediate acceptance in large volume coatings applications. Even to this day, phenolic alkyd is the basis of most of the automotive primers which must have exceptional adhesion, durability and humidity resistance. It is used to fortify the water resistance of air-drying alkyd resins used for refinishing automobiles where they must become shower-proof within a short time.

Alkyd resins of the "pure" type consist usually of a polybasic acid, a polyhydric alcohol and one or more fatty acids. According to the author's personal opinion, "pure alkyd" resins should mean simply a reaction product of a polybasic acid and a polyhydric alcohol with not any fatty acid or any monohydric alcohol or monobasic acid used as a modifying agent. However, it seems to be the established custom of resin manufacturers and of the varnish trade in general to consider alkyds having a fatty acid modification as "pure alkyds" since they are not modified by phenolic condensation products, by other synthetic or natural resins or by ester gum, rosin or rosin derivatives. The nature of the fatty acid largely determines the characteristics of the alkyd which is obtained therefrom. For example, linseed fatty acids may impart drying characteristics to the resin whereas the acids of a non-drying oil generally impart non-drying characteristics. There are, however, many exceptions to this rule. Air-drying is not to be expected from every alkyd, since neither the fatty acids by themselves, nor their esters with mono- and di-hydric alcohols possess (*Please turn to page 56*)

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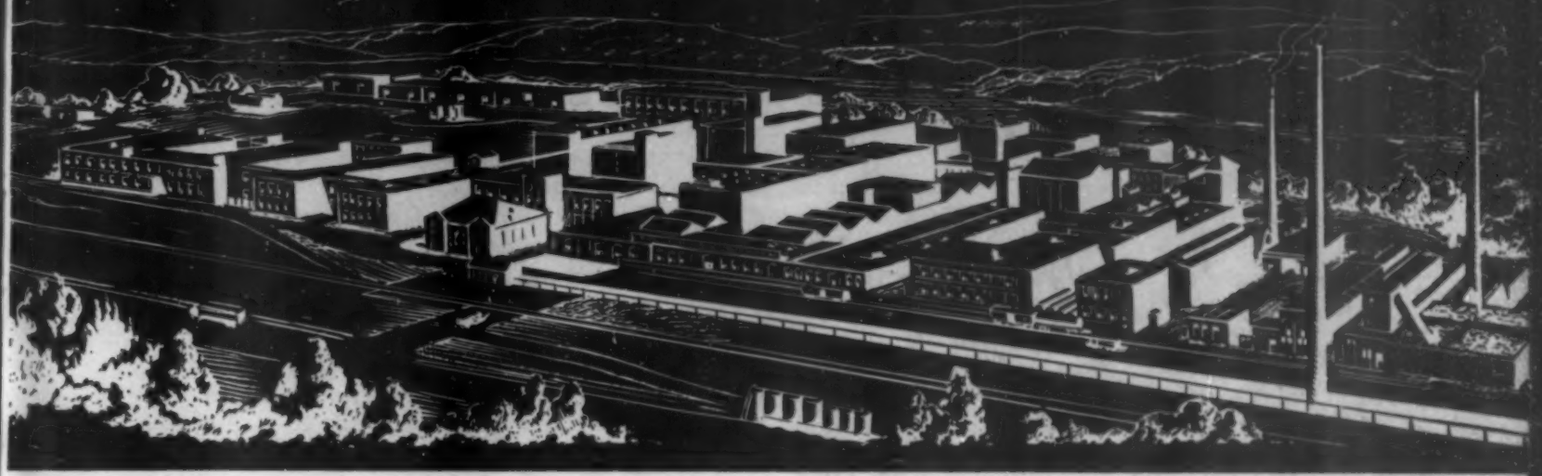

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MOLDS FOR PHENOL RESINOIDS

by T. E. CASSEY*

Continued from our November issue and reprinted by permission from August 1937 issue Journal of The American Society of Naval Engineers

CONSIDERING FIRST, UNDER THE "PHYSICAL Action" classification, the flash molds, we find this group further subdivided into the following subtypes: Overflow, Subcavity.

In general, flash molds differ basically from all other forms of molds in that there is no telescoping of the force plug within the molding cavity, thus the molding cavity is the exact depth of the finished part required.

Flash overflow molds

The flash overflow mold is the simplest form of flash mold. In this type the corresponding surfaces of the force plate and the chase, normally in contact when the mold is closed, are cut away or relieved to form an overflow space or "flash chamber" into which excess material may escape during closure of the mold. It is from this "flash chamber" that the mold derives its name. A narrow strip of contact surface, extending around the periphery of the mold cavity, is retained between the mold cavity and the flash chamber and it is over this "flash" or "cutoff" surface that the excess material flows. The final closure of the mold takes place upon a thin fin of polymerized material thus formed, the halves of the mold remaining separated by the distance equal to the thickness of this fin. The thickness of the fin depends upon the mold pressure, the mold charge and the width of the flash surface. Care must be exercised in this type of mold, to see that the flash area (flash cutoff) is of proper size. Too great an area will produce a heavy fin which is difficult to remove; too little area will cause crushing, due to extreme pressure on the flash area, and will present insufficient resistance to the molding material, producing too low a pressure on the charge for proper molding. In general, the flash surface should be from $1/8$ inch to $3/16$ inch wide.

The flash ridge serves as a means of obtaining back pressure on the molded piece as the material polymerizes during the flow. The requirements for this back pressure and for sufficient strength to withstand mechanical damage by the molding pressures, determine the safe minimum width of the flash ridge. Fin thickness of 0.005 inch to 0.008 inch is desirable, and can be obtained by properly proportioning the cavity and cutoff area when using ordinary molding pressures.

A mold charge containing an excess of material, is used with the flash overflow mold, the additional material being necessary to insure sufficient back pressure to form the molded piece. Where the design of the molded piece permits, the mold charge should be of bulk material, otherwise preforms will be used. With bulk material, the material should be heaped up in the cavity with the apex of the pile near the cavity center.

Ejection of the finished pieces for the flash overflow mold is accomplished by the use of a knockout plate.

In view of their relative simplicity flash overflow molds can be built more cheaply than all other mold types, but as is usually the case with the "cheapest machine," have certain disadvantages. These molds require heavier charges due to the corresponding loss in "flash," and also involve a cleaning operation for the removal of this flash fin. In addition, the pieces produced in flash molds are quite apt to be of less density than pieces produced in other forms of molds, and also their density will not show as good uniformity. Pieces, moreover, will vary slightly in dimension, in the direction of the travel of the force. This is due to the fact that the final effective pressure is exerted directly on the fin of material which has flowed over the flash ridge. Inherently the thickness of this fin will vary with different charges of the same mold and also differ with the cavity of a multiple cavity mold.

Flash overflow molds are in general suitable for the production of relatively simple shapes, and where strength and uniformity are not primary considerations; also where the removal of the fin will not damage the molded surface or such removal operation does not constitute a major item in the cost of the product.

For Naval production this type of mold should be limited to the production of simple forms of insulating bases, bushings, handles, etc., of thin sections, and using woodflour filler material. The use of fabric base materials with flash molds should not, in general, be permitted. For Navy designs, it has been determined that the maximum permissible flash thickness should be such that the finish edge of the piece, after removal of the flash (chamfer), shall not exceed $1/32$ inch. This chamfered edge should be ground smooth and buffed.

The flash overflow mold may have incorporated in its complete classification any of the forms listed under the principles of "Loading," "Closure," "Ejecting" and "Raw Material." Figure 1 shows the essential features of a Flash Overflow Mold; Cavity Loaded, Complete Closure, Knockout Plate, either Bulk or Preformed Material, as applied to Naval production. The mold illustrated is also of the following classification: Unit Construction, Indirect Heated, Hand, Single Cavity.

As will be seen from this sketch, the principal parts of the mold are the top or force plate, the force plug, the bottom plate and the chase. The chase rests on

* Chief Electrical Draftsman of the Bureau of Engineering, Navy Dept.

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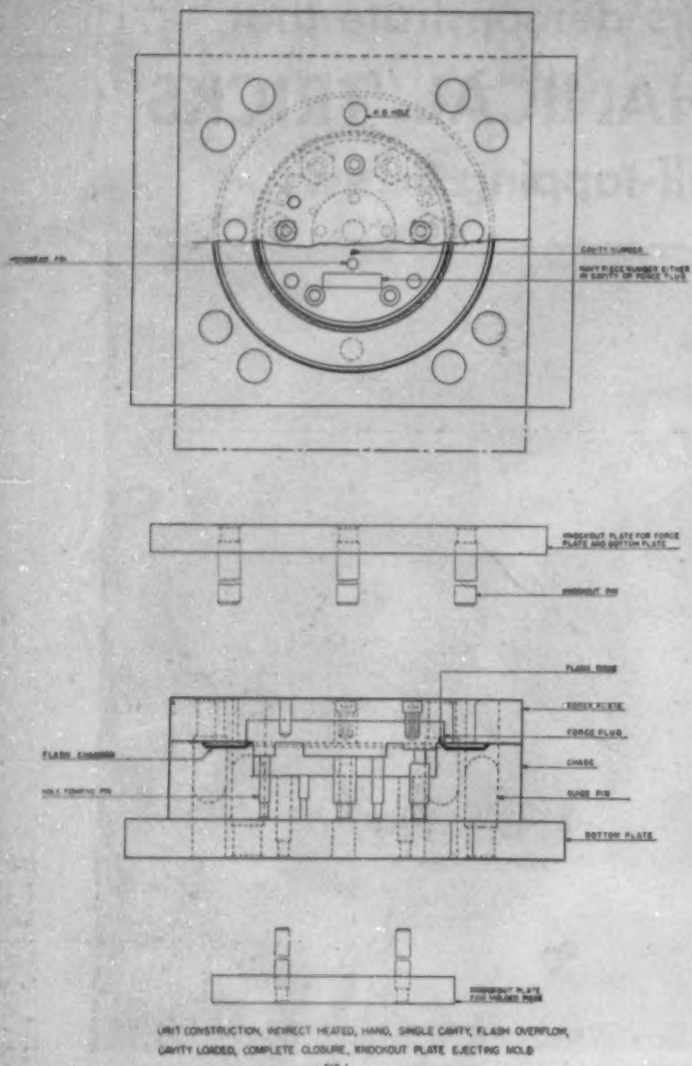


UNIT CONSTRUCTION, INDIRECT HEATED, HAND, SINGLE CAVITY, FLASH OVERFLOW, CAVITY LOADED, COMPLETE CLOSURE, KNOCKOUT PLATE EJECTING MOLD

FIG. 1

the bottom plate being positioned by four large dowels known as guide pins. These guide pins are shown shouldered and riveted to the bottom plate. Riveted to the force plate in like manner are four similar guide pins from which the force plate receives its proper alignment in its downward travel under pressure from the press. Directly in line with the guide pin holes in the chase and in the opposing plates from the top and bottom sets of guide pins, holes are drilled of the same diameter to avoid any possibility of obstructions interfering with the travel of the guide pins as the mold closes.

It will be noted that the guide pins, both in the force plate and the bottom plate are located so as to prevent interchangeability of the plates and also to prevent the positions of those plates being reversed.

Secured to the force plate by cap screws is the force plug which forms the upper face of the molded piece. The force plug is also doweled in position. Due to the construction of the flash overflow mold, where the force plate comes in contact with the top of the cavity in the chase, the force plug is, of necessity, recessed to its full thickness in the force plate. For ease of manufacture, the force plug generally is machined to the more complicated shape of the piece.

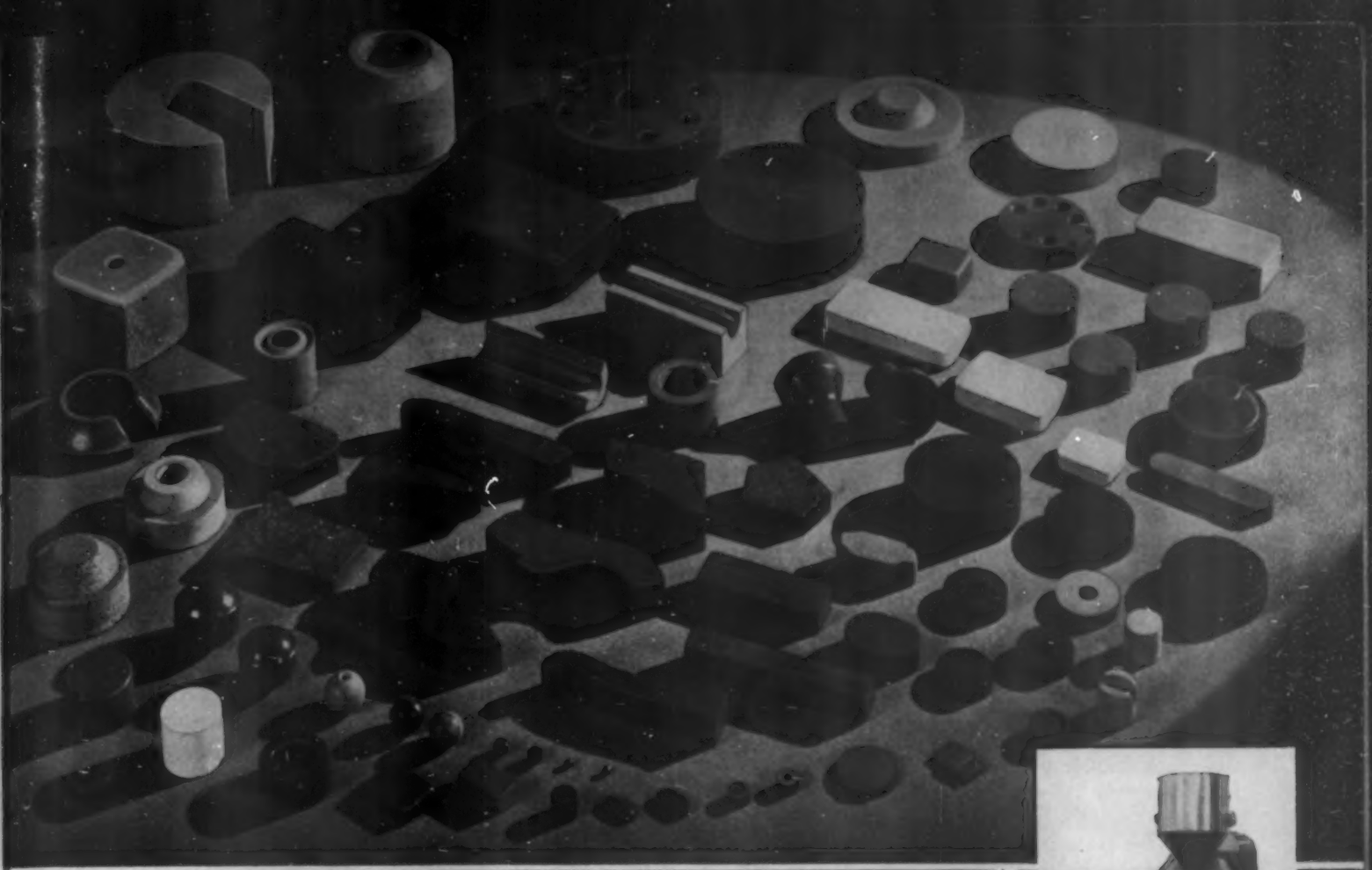
For forming holes in the molded piece, hole forming pins are provided. Figure 1 shows these pins shouldered and riveted in place. Figure 1 does not show any inserts, but where inserts are required, these inserts are positioned by holding pins somewhat similar to the hole forming pins.

Hole forming and insert holding pins should be held sufficiently secure in the mold to withstand molding pressure, and should be easily replaceable. This is rather a difficult requirement and a matter of much controversy. In some cases manufacturers, in order not to secure pins to the mold plates, use a separate plate known as a "pin plate." This is not objectionable, except for the introduction of another piece to the mold assembly.

Holes are shown in the force and bottom plates, which are known as knockout holes, these holes being for the purpose of freeing these plates from the chase after the molding operation. These holes are positioned the same for both plates in order that one knockout plate may be used for the two plates. A group of four "knockout hole" pins are riveted to the bottom plate, these pins extending through the chase to a position flush with the lower surface of the cavity. The holes in the chase through which these pins pass are the knockout holes for the ejection of the piece from the cavity after disassembly of the bottom plate. Molds have been built for the Government having these knockout hole pins loose, and merely fitted into holes in the plates. Although this construction satisfies the "replacement" conditions, which the molders desire, the procedure is obviously unsatisfactory for other reasons, and should be avoided.

To provide the required markings for the finished piece, it will be noted there is shown a manufacturer's monogram pin, a cavity number and a piece number. The monogram pin is a removable pin, usually $^{7}/_{32}$ inch in diameter, and of minimum length not less than three diameters, bearing the molder's monogram or trademark. This pin remains the property of the molder and each molder inserts his own monogram pin as he uses the mold for production. The cavity number is a serial number for the identification of the cavity. This number may be permanently engraved or stamped in the cavity, although some molders use a mold pin for this purpose. The piece number is the Navy number of the piece, and is engraved either in the cavity or on the force plug, as may be required by the design.

A knockout plate for the force and bottom plates, as shown in Figure 1, is furnished as a part of the mold. This plate is fitted with pins of sufficient size and diameter, and in position to suit the knockout holes in the force and bottom plates. By inserting this plate in position and pounding the top of the plate with a padded hammer, or forcing it down in an arbor or knockout press, the mold plates may be knocked free from the chase. A smaller knockout plate for freeing the molded piece from the cavity, as shown in Figure 1, also forms a part of the mold equipment. The pins in this knockout plate fit the knock- (*Please turn to page 55*)



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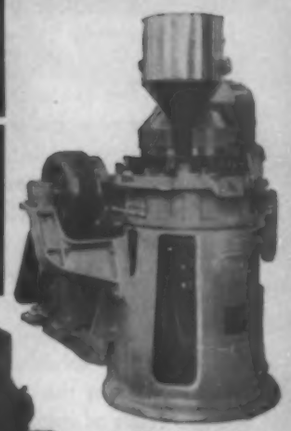

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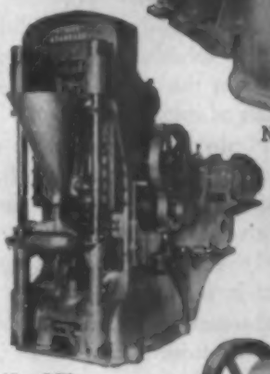

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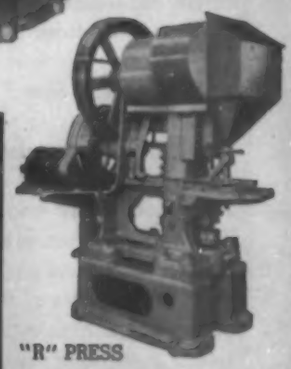

"R" PRESS

F.J.Stokes MOLDING EQUIPMENT

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PLASTICS FROM CORN

A paper by this title was presented before the Third Dearborn Conference on May 25, 1937, by Pendleton Dudley of the Corn Industries Research Foundation. Another paper on the same subject was given at the Midwest Conference of Agriculture, Industry, and Science, Omaha, Nebraska, on March 9, 1937, by J. F. Walsh of the American Maize-Products Company. The following details abstracted from these two sources will serve to illustrate the potential applications of the proteins of corn in the manufacture of plastics. In addition thereto, the processes described in two United States patents for the preparation of transparent films from protein or starch isolated from corn are reviewed in order to bring out the general technique employed in handling these materials. G. M. K.

THE VARIOUS INDUSTRIAL PROTEINS OF CORN are isolated from the gluten which is the residue left from the purification of starch from this grain. The gluten is composed of approximately 50 percent protein, 35 percent starch, 5 percent oil and a small amount of fiber and mineral matter. Three general types of protein material are segregated, namely, the carbohydrate-free protein, the carbohydrate protein free of the aqueous-alcohol-soluble portion, and the aqueous-alcohol-soluble protein called "zein." As this classification indicates, the corn proteins are not readily identified through the usual chemical reactions or formulas, but like other proteins they are separated and classified by their selective solubility in various solutions. They are comprised of albumins which are soluble in water, globulins which are soluble in dilute salt solutions, glutelins which are soluble in dilute alkali, and prolamines which occur only in grains and are soluble in aqueous alcohol solutions. The gluten proteins are all substantially insoluble in water, the water-soluble albumins and some of the more soluble globulins having been previously removed from the corn in the steeping process in the preparation of starch.

The carbohydrate-free protein obtained from gluten is, in general, thermoplastic, relatively light colored and reactive to dilute alkali, formaldehyde, phenol and aqueous alcohol solutions. They thus offer a base for a relatively wide range of plastic products or can be used as a filler in such products. An approximate analysis of the substantially carbohydrate-oil-free bleached protein prepared from this fraction is: Protein 76.5, Ash 1.2, Oil 1.1, Alcohol soluble (eighty percent solution) 35.8, Fiber 4.0, Starch 0.0, Moisture 11.0 percent.

The carbohydrate proteins, free of alcohol-soluble material, differ from the first group of gluten proteins in that they are almost completely soluble in dilute alkali and substantially insoluble in aqueous alcohol solutions. This group is comprised principally of the glutelins and a small amount of globulins. They can be used as fillers or as components of the phenolic resins, or as a starting point for the making of alkaline coating solutions.

The third and most important group constitutes the aqueous-alcohol-soluble prolamines, or zein. It is a substantially white, odorless, tasteless, amorphous solid, similar in many of its properties and characteristics to shellac, casein, and cellulose esters. It is thermoplastic, has a high electric insulation value, is resistant to heat and stable to light, and, although combustible, is non-flammable. It has a molecular weight of 20,000 and a specific graviry of 1.226, is amphoteric with an acid-combining power of 0.00012 at pH 2.8, and has a base-combining power of 0.00020 at pH 10.8. It is insoluble in water, dilute acids, anhydrous alcohols, turpentine, esters, oils, fats, ethers, ketones, chlorinated solvents, petroleum and coal-tar hydrocarbons, ammonia, borax and sodium and potassium carbonates. Aqueous alcohols, strong organic acid solutions, dilute 0.5 percent sodium and potassium hydroxide solutions, dilute ethylenediamine or monoethanolamine solutions, liquid ammonia, molten phenol, cresol, Petrex, rosin and strong solutions of urea are very effective solvents. A typical analysis of a commercially produced product is: Protein 87.5, Alcohol soluble (80 percent solution) 90.0 (dry basis), Ash 0.4–0.5, Oil 0.4–0.5, Moisture 8.0 percent.

Zein is compatible with many of the cellulose derivatives, plasticizers and synthetic and natural resins, and can be compounded to transparent, clear, glasslike, stable products, suitable for use in novelties, sheeting and coatings, such as are now made from cellulose derivatives and natural and synthetic resins. Furthermore, it is relatively highly reactive and thus offers a prospective base for new synthetic resins.

Obviously, the use of corn in this field would open up a limitless and dependable source of raw material. Corn is the number one crop of the United States in acreage, yield and incidentally in value. About 10 percent of the corn kernel is made up of protein. On the basis of the 56 pound bushel there is thus available more than 5½ pounds of plastic-making material for every bushel of corn that is raised. As many as 3,208,584,000 bushels of corn have been raised in the United States in one year.

United States Patent 2,074,332, issued March 23, 1937, to D. W. Hansen and assigned to Prolamine Products Incorporated describes a transparent flexible film adapted for the wrapping of packages which is prepared from the corn protein, zein. The zein is extracted from corn gluten by dissolving it in a mixture of alcohols and some water. As the result of (*Continued on page 72*)

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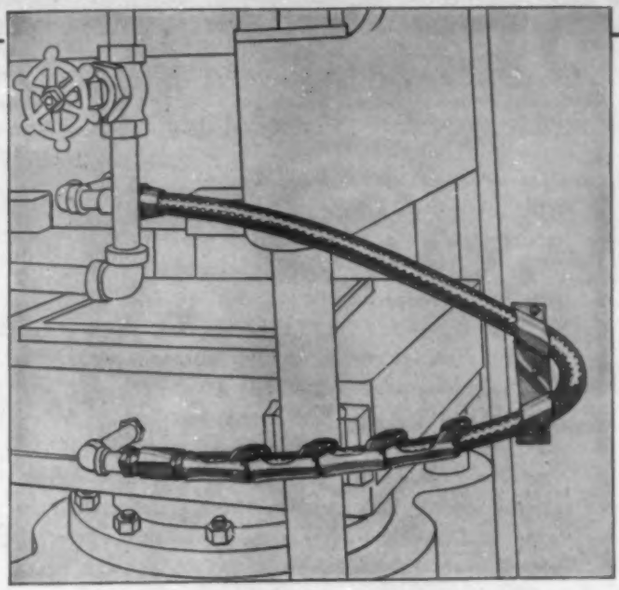

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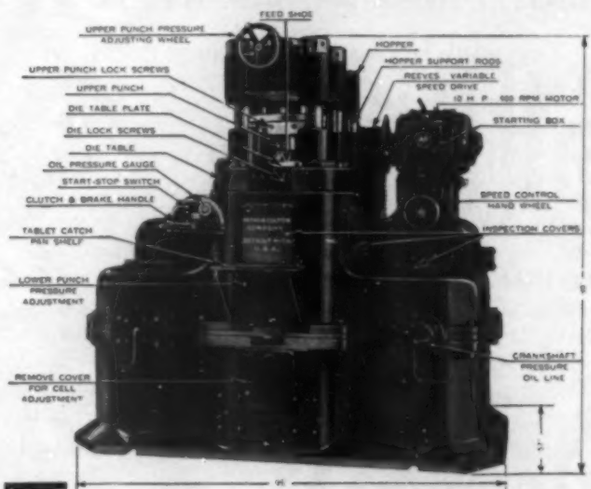

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IMMENSE EXPANSION OF GERMAN SYNTHETIC RESIN PRODUCTION

by CONSUL SYDNEY B. REDECKER

GERMANY'S PRODUCTION OF SYNTHETIC RESINS has recorded immense expansion in recent times, each succeeding year registering the attainment of a new peak level of output far surpassing the preceding year. In 1933 output of molding resins amounted to some 8000 metric tons and by 1935 had increased to 25,000 metric tons valued at around 35,000,000 marks. Trade reports indicate a further expansion of production of around 30 percent in 1936 to some 32,000 metric tons, while current production trends point to further immense gains this year of 40 to 45 percent above 1936's high figure, which will probably advance national output for all 1937 to the astoundingly high level of around 45,000 metric tons.

In 1936 Germany's total production of plastic materials of all kinds amounted to around 50,000 metric tons, or around one-fifth of the total world supply. Of this amount around 32,000 tons comprised molding synthetic resins and the balance non-molding resin (for lacquer, adhesive and related purposes), celluloid, galalith and other types. Output of celluloid (excluding, of course, film) in 1935 amounted to around 5000 metric tons (compared with some 9000 tons in 1929) with indications of considerable gains in 1936 and this year, although authentic data are unavailable. Production of galalith amounted to around 3000–3500 tons in 1935 but it would appear that since then decrease rather than increase has occurred in production of this material, although here again authentic data are lacking.

Although phenolic condensation products have continued to comprise the great bulk of the German molding synthetic resin output, signs have been developing of considerable gains for other types, notably injection molding resins of the polystyrol and vinyl series. In 1936 Germany's production of injection molding resin amounted to 450 metric tons. The perfection of completely automatic injection molding machinery has given a considerable impetus to injection molded products, with indications of their growing importance in the future in the entire plastics field.

While the technical progress being achieved by the synthetic resin industry, including the improvement of molding machinery, etc., has of course contributed to the expanded production in Germany, the use of synthetic resins has been given a particularly strong impulse owing to their status as virtually purely domestic raw materials for serving in replacement of imported raw materials, including the heavier non-ferrous metals, iron, fine hardwoods, cork, natural varnishes and gums, etc., under the now intensively prosecuted "Four Year Plan" of maximum possible national economic independence. Indeed, synthetic resin plastics were making such rapid gains at the expense not only of imported raw materials but other competing domestic products like porcelain and glass, that the Government felt obliged recently to intervene and impose restrictions upon the use of plastics for purposes already adequately served by competing products of domestic origin, so that the production of the synthetic resin plastics would be devoted exclusively to replacing products based upon imported raw materials.

The marked upward curve of exports has also assisted in expanding Germany's production of synthetic resins, and the increase of outcoming shipments has been so pronounced in recent times as to raise the export trade to volume levels this year well over 100 percent above those of 1932, as shown by the following table:

GERMANY'S EXPORTS OF SYNTHETIC RESINS

Year	*Quantity* (Metric Tons)	*Value* (Reichsmarks)
1932	3805	4,988,000
1933	4824	6,191,000
1934	5442	6,577,000
1935	5383	6,438,000
1936	6421	7,321,000
FIRST HALF YEAR		
1936	2830	3,264,000
1937	4263	4,726,000

The great bulk of the German exports of synthetic resins are destined to European countries and virtually all the European countries, except Spain, have increased their purchase considerably in recent times. German exporters have also achieved considerable success in expanding their shipments to Latin American markets, headed by Argentina and Brazil. Shipments to Argentina decreased from 1934 to 1936 but this year has witnessed a marked revival of sales to that country to new record levels, while exports to Brazil have continued their uninterrupted expansion to a volume this year over five times greater than in 1934.

The following table affords a comparison of the geographical distribution of Germany's exports of synthetic resins in recent years and reveals the substantial gains recorded in shipments to virtually all leading buying countries: (*Please turn to page 66*)

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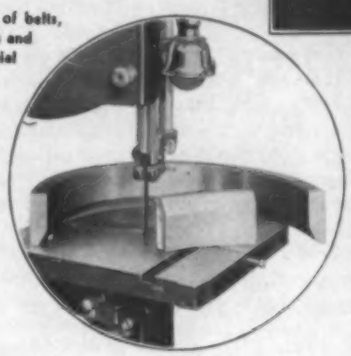

One of these draw-die segment rings was impractical to cut on the milling machine because of the diameter of cutter required; the other because the diameter of the ring was too large for the milling machine. Both, however, are cut with ease and speed on the Delta band saw. Try your next "awkward" job on one of these versatile tools.

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PLASTICS DIGEST

This digest includes each month the more important articles (wherever published) which are of interest to those who make plastic materials or use them

General

PLASTICS AND THE METAL INDUSTRY. H. R. Simonds. Iron Age *146*, 40–45 (Sept. 16, 1937). Metal hardware may be plastic coated by dipping or by injection molding of plastics over the metal. This article deals chiefly with injection molding. Metal fabricators, especially those in the small article branch of the industry, are cautioned to consider plastics in combination with metal, for, states the author, "Either the metal fabricators must take over plastics and adapt them to their use or the plastics fabricators will take over metals."

RESIN-IMPREGNATED WOOD. Plastics (London) *1*, 166–8 (Oct. 1937). A discussion of the properties of a resin-impregnated wood made in Finland and used in the construction of small boats. Experimental work on the production of barrels and airplane structures from the same material is described and illustrated. Physical properties of a typical composition are: Tensile strength 28,000 lb. per sq. in., compressive strength 18,000 lb. per sq. in., shear strength 3,000 lb. per sq. in., modulus of elasticity 3,000,000 lb. per sq. in., density 60 to 80 lb. per cu. ft. The moisture absorption is 2 percent increase in weight and 2 percent increase in volume after 24 hours immersion.

PLASTICS EXHIBITS. R. Lepsius. Kunststoffe *27*, 271–2 (Oct. 1937). The author outlines basic principles which should be observed in preparing exhibits, based on his experiences at Düsseldorf and Frankfurt.

WOOD FILLERS: SOME USES AND FORMULAS. C. F. Mason. Chemical Industries *41*, 207 (Sept. 1937). Formulas are given for caulking compounds, woodflour fillers, specialty fillers, and plastic woods. A typical composition in parts by weight for the plastic wood type is: pyroxylin 24, shellac 12, rosin 10, alcohol 16, acetone 20 and wood alcohol 18. Presumably woodflour filler is added to produce a mixture of the desired consistency. The inflammable nature of the pyroxylin and solvents necessitates precautions in handling them.

Materials and manufacture

DEVELOPMENT OF DAKOTA LIGNITE: PREPARATION AND PURIFICATION OF PHENOL-FORMALDEHYDE RESINS FROM PRIMARY TAR DISTILLATE. W. Frantz, I. Lavine, and L. C. Harrington. Ind. and Eng. Chem. *29*, 1182–7 (Oct. 1937). The practicability of reacting lignite tar acids with formaldehyde without first separating them from the neutral oils of the tar was demonstrated. By washing the initial condensation product with petroleum naphtha, a resin can be obtained of sufficient purity to produce varnishes of high dielectric strength when subjected to electrical breakdown tests.

CASEIN PLASTICS. G. Besana. Materie Plastiche *3*, 181–8 (1936). A review of the preparation, properties and applications of casein plastics.

Molds and molding

VULCANIZED LATEX MOLDS FOR PLASTER CASTING. Adolph Silver. Rubber Age *42*, 31–34 (October 1937). Detailed directions are given for the preparation of flexible molds with vulcanized latex. It is claimed that such molds, in contrast to glue compositions, are not affected by water or heat under any conditions or by any type of casting material. Thousands of casts can be made from a single mold of this type.

DISHING DURING HEAT-TREATMENT. J. W. Quantius. Am. Mach. *81*, 945–6 (Oct. 6, 1937). Changes in material and method lessened breakage of record molds in the plant of the RCA manufacturing company.

Applications

SYNTHETIC RESIN BEARINGS. E. Heidebroek. Kunststoffe *27*, 263–7 (Oct. 1937). Observations on various factors involved in the operation of synthetic resin bearings, including clearances, temperature and frictional effects, are presented.

NEW PLASTIC MATERIALS DEVELOPED FOR SHOEMAKING. N. P. Daly. Hide and Leather *94*, 20–1 (Nov. 6, 1937). A brief account of the use of plastics for shoe trees, lasts and heels.

"MIPOLAM" TUBES, A NEW MATERIAL FOR PIPING. Hans Lutz. Kunststoffe *27*, 81–3 (Mar. 1937). The properties of a polymerized vinyl chloride resinous product, known as "Mipolam," which has been found to be suitable for the construction of piping for various industrial liquids, are listed as follows: Specific gravity 1.38, breaking strength 600 kg. per sq. cm., elongation 17–20 percent, modulus of elasticity 30,000 to 40,000 kg. per sq. cm., coefficient of expansion 65.1×10^{-6}, heat resistance (Vicat) 89°C., and impact strength 100 cm.-kg. per cm. sq. The material is said to be resistant to acids and alkalies, alcohol, petroleum hydrocarbons, mineral and vegetable oils, and water. It is attacked by esters, ketones and chlorinated solvents. Special pipe-fitting methods used with this type of material are described in this article and in one by E. Wick on pages 84–5 of this same journal.

PLASTICS: A NEW FACTOR IN BUILDING. Barron's *17*, 4 (Sept. 20, 1937).

CONSTRUCTION AND CHARACTERISTICS OF NON-METALLIC GEARS. J. Delmonte. Power Plant Eng. *41*, 488–9 (Aug. 1937).

DEVELOPMENT OF CELLULOSE TRIACETATE FILMS FOR ELECTRICAL INSULATING PURPOSES. P. Nowak and H. Hofmeier. Kunststoffe *27*, 1–2 (1937). Data on the properties of cellulose triacetate films with and without plasticizers are presented.

Synthetic coatings

SOME SPECIAL FINISHES FOR METAL PRODUCTS. G. Klinkenstein. Metal Industry *35*, 507–8 (Oct. 1937). A brief statement, without details of composition, of various finishes which have been recently developed, including heat-resisting, burnproof, machinable, flock, hammered and anticorrosive types. A blackboard enamel for use on metal, which will take chalk marks and can be cleaned with the usual erasers, is of special interest to educational institutions and manufacturers who are looking for a lightweight product.

FILM FORMATION WITH CELLULOSE DERIVATIVES. S. E. Sheppard and P. T. Newsome. J. Soc. Chem. Ind. (London) *56*, 256T–261T (Aug. 1937).

THE STRUCTURE AND MECHANICAL PROPERTIES OF PROTECTIVE FILMS. G. F. New. J. Soc. Chem. Ind. (London) *56*, 261T–266T (Aug. 1937).

THE STRUCTURE AND ELECTRICAL PROPERTIES OF PROTECTIVE FILMS. L. Hartshorn, N. J. L. Megson, and E. Rushton. J. Soc. Chem. Ind. (London) *56*, 266T–270T (Aug. 1937). This article and the two preceding ones are excellent reviews of our present knowledge of the fundamentals of film structure and its effect on the physical properties of the protective coating.

SOME RELATIONS BETWEEN STRUCTURE AND PHYSICAL PROPERTIES OF PAINT FILMS AND POLYMER PLASTICS. A. V. Blom. J. Oil Colour Chem. Assoc. *20*, 195–212, 219 (1937).

Chemistry

CHEMICAL TEST METHODS FOR RESINS. L. Metz. Kunststoffe *27*, 267–71 (Oct. 1937). A review, covering analytical procedures, stability toward moisture, chemicals, solvents, and oils, corroding action on metals, temperature effects, flammability, physiological action and so forth.

INFLUENCE OF SOLVENTS AND NONSOLVENTS ON THE NITROCELLULOSE MOLECULE. Fritz Zimmer. Farben Zeitung *42*, 438 (1937). Cf. Paint and Varnish Prod. Mgr *17*, 20–2 (Nov. 1937). The author discusses the action of various liquids on this cellulose derivative. Work in this field has indicated that systematic research is a necessary prerequisite to systematic technical progress.

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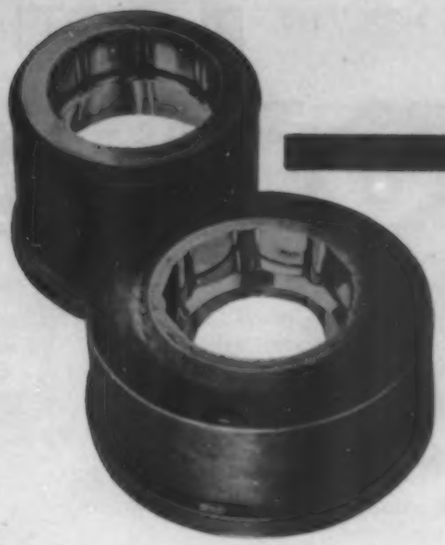

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U. S. PLASTICS PATENTS

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 10 cents each

THERMOPLASTICS. H. P. Bassett (to Meigs, Bassett and Slaughter Inc. U. S. 2,095,961, Oct. 19. Removing residual solvent, but not plasticizer, from a thermoplastic cellulose ester coagulum by immersing it in aqueous alcohol and gradually diluting the alcohol with water.

ADHESIVE. H. G. Kittredge and S. J. Broderick (to Foilfilm, Inc.). U. S. 2,096,110, Oct. 19. An adhesive made of 25% viscous chlorinated diphenyl, 50% solid chlorinated diphenyl and 25% of a mixed para-coumarone-indene resin.

BENZYLCELLULOSE. E. J. Lorand (to Hercules Powder Co.). U. S. 2,096,114, Oct. 19. Viscosity reduction in benzylcellulose is effected by adding to the benzylation system more than enough of an alkali fixative to neutralize all the excess alkali in the system, and heating the reaction mass.

CABLE COATING. P. M. Clark (to E. I. du Pont de Nemours and Co.). U. S. 2,096,448, Oct. 19. A flexible rubber-and-fabric insulated cable is coated with a plasticized nitrocellulose lacquer containing an incompatible nonvolatile mineral oil which exudes and forms a protective film on the surface.

ADHESIVE. W. Kraus and W. Fisch (to Society of Chemical Industry in Basle). U. S. 2,096,521, Oct. 19. A stable dry solid which yields a hardenable adhesive cement comprises a solid nonhardenable urea-formaldehyde resin, and acid hardening agent and formaldehyde, mixture being water-soluble and able to form a hardenable resin.

SHEET MATERIAL. Erich Gebauer-Fuelnegg and E. W. Moffett (to Marbon Corp.). U. S. 2,096,632 and 2,096,633, Oct. 19. Making sheet material by compounding rubber hydrochloride with a natural resin (rosin) or with a synthetic resin (polycoumarone).

ADHESIVES AND PLASTICS. H. A. Winkelmann; H. A. Winkelmann and E. W. Moffett (to Marbon Corp.). U. S. 2,096,660, 2,096,661 and 2,096,662, Oct. 19. An adhesive in sheet form, made of rubber hydrochloride, chlorinated paraffin and a tacky paracoumarone-indene resin; a plastic composition of rubber hydrohalide and ester gum, and a composition of rubber hydrochloride, coumarone resin and sulphur.

CELLULOSE ETHERS. E. J. Lorand (to Hercules Powder Co.). U. S. 2,096,681, Oct. 19. Etherifying cellulose in two stages, first by rapid heating to 120–150°C. to effect a superficial etherification which will protect the cellulose from degradation by alkali, and finally at 105–120°C. for a longer time to complete the reaction.

VARNISH. J. B. Rust (to Ellis-Foster Co.). U. S. 2,096,764, Oct. 26. A light colored tung oil varnish made with a phenol-acetaldehyde resin in which the phenols are derived from tar acids and consist largely of m-cresol and symmetrical xylenol.

CORK-COATED FABRIC. Howard L. Munroe. U. S. 2,097,089, Oct. 26. Imitation leather is made by coating fabric with nitrocellulose or cellulose acetate, drying, applying a second coat and immediately dusting with a thick layer of cork, drying quickly by heat, and calendering the dried coating.

THERMOSETTING RESIN. T. Sutter (to Soc. of Chem. Ind. in Basle). U. S. 2,097,109, Oct. 26. Making a heat-hardenable moldable resin by condensing a primary arylamine with more than 2 mols of formaldehyde and an acid condensing agent in an organic solvent.

POLYMER. D. E. Strain (to E. I. du Pont de Nemours and Co.). U. S. 2,097,263, Oct. 26. Polymerizing a monomeric methacrylic acid ester in presence of sulphur dioxide.

COATING ROLL. G. B. Watkins (to Libbey-Owens-Ford Glass Co.). U. S. 2,097,315, Oct. 26. A protective coating for the rubber body portion of coating rolls is made of an alkyd resin.

RESIN. H. S. Rothrock (to E. I. du Pont de Nemours and Co.). U. S. 2,097,345, Oct. 26. Making a resin by condensing a diphenylolmethane dicarboxylic acid with an aldehyde and then with an alcohol.

ARYLCARBINOL RESIN. J. H. Shipp (to E. I. du Pont de Nemours and Co.). U. S. 2,097,348, Oct. 26. Self-condensation of arylcarbinols to form resins by heating in dilute (0.1 to 5%) sulphuric acid at a temperature at which the water of reaction distils off.

CLEAR CELLULOSE ACETATE. C. J. Malm (to Eastman Kodak Co.). U. S. 2,097,464, Nov. 2. Making haze-free cellulose acetate by presoaking cellulose in acetic acid, then fully acylating in acetic acid containing 3–25% of propionic and butyric acids.

VINYL POLYMERS. J. W. C. Crawford (to Imperial Chemical Industries, Ltd.). U. S. 2,097,586, Nov. 2. Vinyl polymers having increased transparency to ultra-violet light are made by polymerizing a vinyl or alpha-substituted vinyl compound in presence of a peroxide of a dibasic organic acid.

GRINDING WHEEL. B. Sanford (to Norton Co.). U. S. 2,097,803, Nov. 2. A thin cutting-off wheel is made with an outer ring of diamond grains bonded with a resinoid, compacted to a dense texture, and a rigid central supporting zone bonded with a resinoid in about the same proportion as in the outer ring but with a different granular filler.

RESIN. E. C. Rossiter (to American Cyanamid Co.). U. S. 2,097,-895, Nov. 2. Forming a resin by condensing dicyandiamide with formaldehyde and an acid which may be stearic, oleic linoleic, ricinoleic, butyric, camphoric, sulphanilic or naphthalene sulphonic acid.

CELLULOSE ESTER. C. J. Malm (to Eastman Kodak Co.). U. S. 2,097,954, Nov. 2. Making a high viscosity cellulose mixed ester in which acetyl groups predominate, by esterifying in a bath in which most of the acylating agent is acetic acid while from 5 to 40% is made up of propionic and butyric acids.

ADHESIVES. A. H. Bowen and T. W. Dike (to I. F. Laucks, Inc.). U. S. 2,098,082 and 2,098,083, Nov. 2. A composition of cellulosic material with a zinc chloride-urea-formaldehyde condensation product; and a sizing and adhesive material made from a zinc chloride-urea-formaldehyde resin and another ingredient which may be casein, glue, starch or gum arabic.

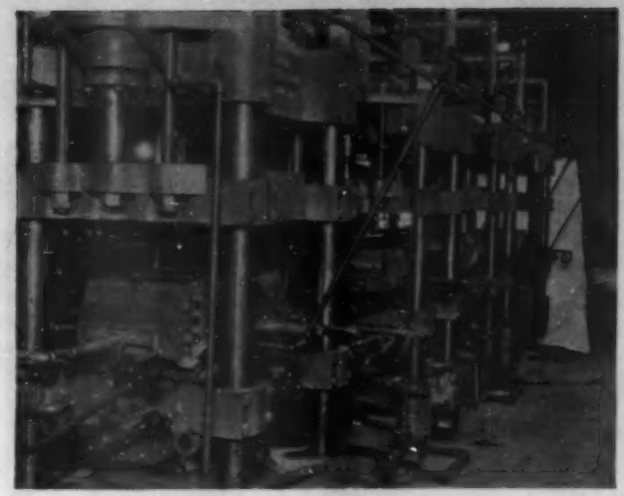
VINYL ETHERS. W. Reppe and E. Kuhn (to I. G. Farbenindustrie Aktiengesellschaft). U. S. 2,098,108, Nov. 2. Polymerizing a vinyl ether, e. g., glycerol formaldehyde acetal vinyl ether, in presence of sulphur dioxide.

CELLULOSE ETHERS. Henry Dreyfus. U. S. 2,098,335 and 2,098,-336, Nov. 9. Making cellulose ethers by reaction of fibrous cellulose with etherifying agents in presence of alkylamines; and making cellulose ether-esters from the product by the action of esterifying agents.

RESIN COMPOSITIONS. Jos. Rivkin (to Neville Co.). U. S. 2,098,361 and 2,098,362, Nov. 9. Selective recovery of alcohol-soluble and less soluble resins from a solvent naphtha system by treating with a phenol to form a phenol-modified coumarone resin and extracting with an aqueous solution of a base; and blending the alcohol soluble resin of such a system with cellulose acetate.

LACQUERS. Wm. R. Marshall (to Resinous Products and Chemical Co.). U. S. 2,098,503, Nov. 9. Making fast-drying lacquers from nitrocellulose, a drying oil modified alkyd resin and a cobalt-manganese dryer.

PHENOLIC RESIN. J. Harmon and F. M. Meigs (to E. I. du Pont de Nemours and Co.). U. S. 2,098,869, Nov. 9. Making a synthetic resin by condensing a phenol with formaldehyde in presence of methylamine at a low temperature, allowing the heat of reaction to raise the temperature to 40°C. and completing the resinification at 100°C.



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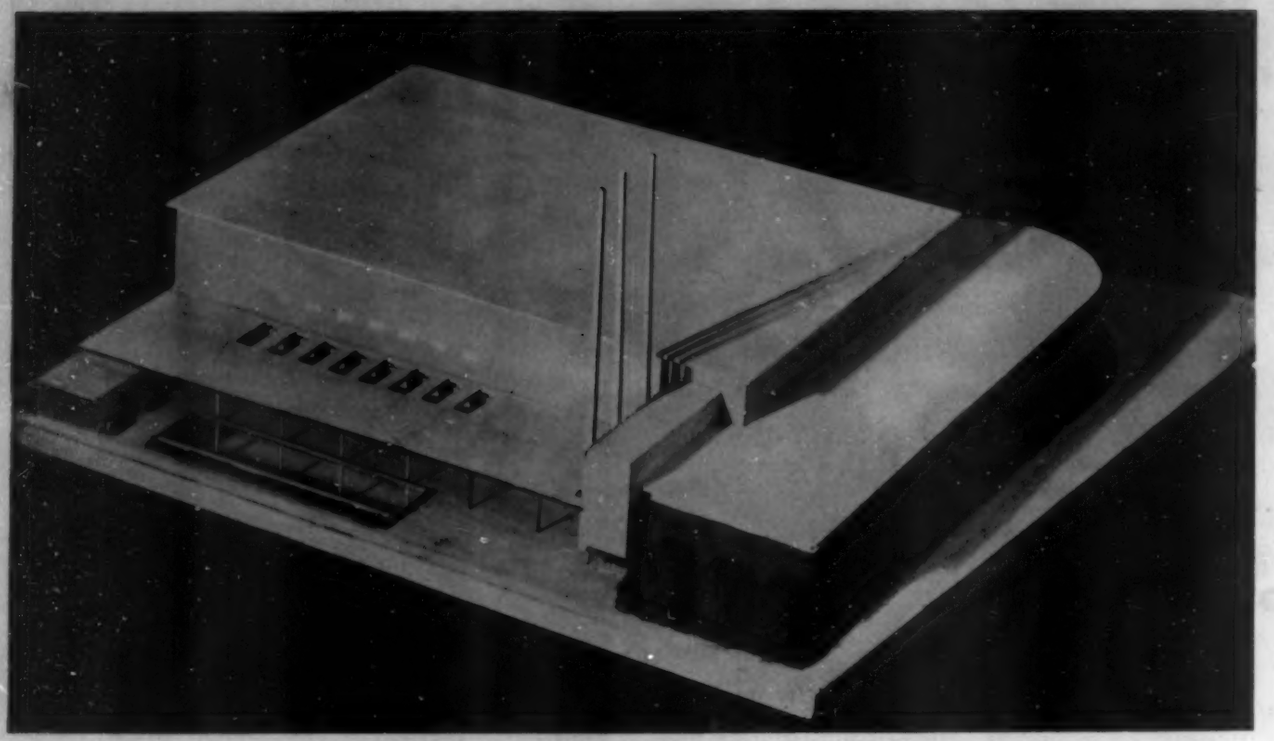
NEWS



CHEMICALS AND PLASTICS ARE AMONG THE great modern industries to be given special prominence in the display plan of the New York World's Fair, it was disclosed recently when Grover A. Whalen, President, made public the designs for a building to be devoted exclusively to their exhibits which is pictured above.

The site of the Chemicals and Plastics Building is centrally located in the Means of Production Zone on the swing of the outer avenue leading from the Theme Centre of the exposition to the eastern focal plaza near Horace Harding Boulevard and the head of the Amusement Zone.

The Fair Corporation has scheduled construction of the building for early 1938. As shown in model and drawing, it takes the form of a square affording a minimum of 18,000 square feet of net display space arranged for easy circulation of visitors about island exhibits.

Features of the avenue facade are a portico covering continuous plate glass windows, a broad mirror-flanked entrance, and an adjutting, massive light tower of unique style. Plans call for a mirror pool before the structure and elaborate landscaping of the grounds adjoining. Dominating the whole will be a trio of 90-foot quadriferilons, worked into the lighting tower.

Mr. Whalen stated that special provisions for chemicals and plastics conformed with the position these fast-growing industries occupy in everyday life.

"The industrial chemist and plastics manufacturer are among the outstanding contributors to our modern way of life," he said, "and they are doubly important to a forward-looking Fair because scarcely a day passes but what they offer to humanity some new product making for our comfort or delight. They have fostered industries that are fast-growing, indeed, but they have more to show, perhaps, than some of the older manufactories.

"We have, therefore, afforded the chemicals industry and its kindred plastics industry the opportunity of presenting dynamic and educational displays that are going to surprise millions of visitors."

Mr. Whalen pointed out that these allied industries have worked their way quietly into general manufacturing and household and that their products number by the thousands. The majority of persons, he said, had little true knowledge of the source or the nature of products contributed by the chemicals industry.

The manufacture of rayon, fumigation, mechanical refrigeration, motion picture projection, steel manufacture, paper making, waterproofing, electroplating, dyeing, perfume making, tanning, rubber making, oil refining, soil stimulation, paint making, meat packing and modern packaging are among the many purposes today made possible and served by modern chemistry, Mr. Whalen recalled. The plastics manufactories, he said, have given us table tops, radio devices and an almost uncountable number of modern conveniences.

The Chemicals and Plastics Building was designed by Joseph H. Freedlander and associates, Maximilian Bradford Bohm and Charles W. Beeston. Its cost is set at two hundred thousand dollars.

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NEWS

AFTER SEVERAL YEARS OF EXHAUSTIVE EXperimentation in its research and development laboratories, Bakelite Corp. announces a superior thermoplastic material for low loss purposes identified as Bakelite polystyrene molding material (XMS-10023). Polystyrene possesses a loss factor of less than .00053, a power factor of less than .0002, and a dielectric constant of 2.60 at 60 cycles, 1,000 cycles and 1,000,000 cycles. This molding material is claimed to offer

Coil forms, tube bases, terminal blocks, spacing washers, and connector blocks produced from Bakelite polystyrene molding material

marked advantages for many electrical products and equipment parts. Its dielectric strength is more than 500 volts per mil; its resistivity 10^{9} megohmcentimeters; and its arc resistance 240–250 seconds. Tests indicate that no noticeable change occurs in electrical properties with an increase in temperature or humidity.

In addition to these electrical advantages Bakelite polystyrene molding material provides the important merits of: uniformity in molding; freedom from crazing or surface difficulties; permanence of dimension; and high resistance to water, acids and alkalies. Its durability and toughness are indicated by its A.S.T.M. impact strength of .16 to .20 foot pounds; flexural strength of more than 7,000 pounds per square inch; and tensile strength of 5,000 to 5,500 pounds per square inch.

Opportunities for the improvement of high frequency apparatus and equipment through application of this new type of Bakelite molded are many. Following are specific electrical properties of the material:

Cycles per Second	Power Factor
60 cycles	.0001 to .0002
1000 cycles	.0001 to .0002
1,000,000 cycles	Less than .0002
Dielectric Constant	**Loss Factor**
2.60	.00026 to .00053
2.60	.00026 to .00053
2.60	Less than .00053

Dielectric Strength 1/8" Step Method—500 to 525 volts per mil. Volume Resistivity—Over 10^{9} megohmcentimeters. Arc Resistance (Proposed A.S.T.M. Method)—240 to 250 seconds.

THE AMERICAN CYANAMID & CHEMICAL CORporation announces that it has opened a western sales office for the Beetle Products Division at 20 North Wacker Drive, Chicago, Illinois. Wm. F. Torres, formerly New England representative for Beetle Products, has been made western branch sales manager and will cover the middle western territoty.

WILLIAM L. SEARLES, NEW YORK CITY REPRESentative of Tennessee Eastman Corp. has moved his office from 171 Madison Avenue to more adequate accommodations at 10 East 40th Street, Suite 4105. John P. Tokarz who for the past several years has been associated with the company at Kingsport, Tenn., has been appointed assistant to Mr. Searles.

AMERICAN MANUFACTURERS AND FABRICAtors of pyroxylin merchandise would be wise to stamp their products "Made in U. S. A." to avoid any misapprehension that they are made in countries whose merchandise is being shunned by many shoppers.

IT HAS JUST BEEN POINTED OUT TO US THAT the toys illustrated on page 182 of our October issue, were molded by the Kilgore Mfg. Co. The material used was Lumarith.

JOHN W. MASURY & SON, MASURON DIVISION, announces the development of a new cellulose acetate powder for injection molding. It is identified as the New 500 series and a folder describing its outstanding characteristics is ready for distribution.

CARLETON ELLIS, WHOSE RESEARCH LABORAtories in New Jersey operate under the name of Ellis-Foster Company, has recently received his seven-hundreth grant from the U. S. Patent office. This places him third among American inventors holding the greatest number of U. S. Patents.

THE LAKE ERIE ENGINEERING CORP. ANnounces a new semi-automatic hydraulic molding press for quantity production of molded plastic and rubber parts at low unit cost. This is a fast production tilting head ptess with automatic multiple ejection of the molded forms and is available with either self-contained pumps or for accumulator operation.

GEORGE J. CROSMAN, JR., ANNOUNCES THAT he has formed a new injection molding company to be known as Molded Plastics Inc., and which will be located at 300 Atkins Avenue, Neptune, N. J.

THE SIXTEENTH EXPOSITION OF CHEMICAL Industries is being held at Grand Central Palace during the week of December 6th. The Exposition will exhibit chemicals and chemical products, plant equipment, laboratory equipment and supplies, instruments, metals and alloys, electrical instruments, electrical equipment, and materials handling equipment.

WHEN

A MAJOR OPERATION

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- Build up its Strength and Endurance
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- Put Pep into Sales

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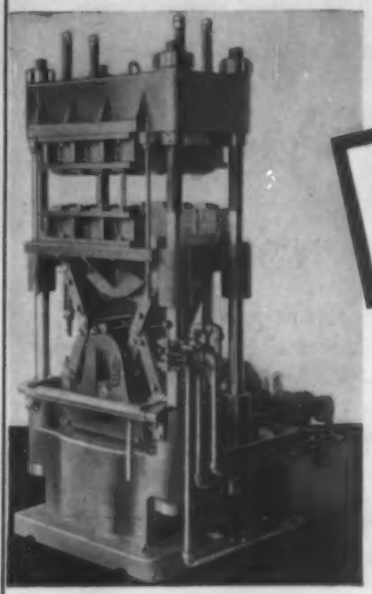
for Plastic Molders



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Because Standard Presses operates on comparatively low pressure on the platen, *hydraulic packings last longer*. The only packings in the hydraulic cylinder are around the piston rod and they can be readily renewed without dismantling the machine, when it is necessary to replace them.

Lower maintenance cost is but one reason why many molders are specifying Standard Self-Contained Molding Presses. Write for more detailed information about these efficient, economical presses.

50 — 100 — 150 — 300 Tons

This is one of a series of advertisements explaining why Standard Self-Contained Molding Presses are specified by many plastic molders. Let us tell you how these presses can show you new ways to efficient and economical molding. Send for new folder.

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PUBLICATIONS

Booklets reviewed in these columns will be sent without charge to executives who write for them on their company letterheads. Other books will be sent postpaid at the publishers' advertised prices

Decorative Art

1937 Year Book of "The Studio"

Edited by C. G. Holme

Published by Studio Publications, New York, N. Y.
Paper $3.50 **Cloth $4.50**

Published in February this year, Decorative Art takes its readers on a delightful pictorial tour through the best modern homes in England and the United States, pointing out the advantages of new ideas, changes and improvements which architects and decorators have created for this gracious age.

"The function of the architect and designer," says the editor in his introduction, "becomes, apart from his technical knowledge, not that of a man of taste, but an interpreter of social life. He must solve among other things questions of etiquette, of hygiene, of the purse. He must allow sympathetically for the active pursuits and pleasures of his clients as well as their passive existence in the surroundings he provides; and they in turn will raise these questions if they are minded to have a home that fits them, instead of finding themselves enclosed in unsuitable surroundings. It is as a social science that we may expect to see developments in architecture and decoration."

Exteriors are treated in a chapter of their own with due regard for setting and environment and many examples of divergent opinions and tastes are expressed in splendid illustrations. Interiors are classified from Entrance Hall, through Living Room, Dining Room, Bed Room, Kitchen, to Bath; while table arrangement, pottery and glass, metalware, lighting, furniture, fabrics and carpets exhibit the best thought of prominent designers and manufacturers in these important accessories.

Modern Furnishing and Decoration

by Derek Patmore

Printed in England by Studio Publications
Price $4.50 **160 pages.**

This is a sequel, so to speak, to Mr. Patmore's excellent presentation of the Decorator's Art published in 1934 and brings one a clear descriptive picture of home furnishing trends from both sides of the Atlantic for easy comparison. It is a guide rather than a textbook in which the author attempts to give practical suggestions for arranging furniture and color schemes, together with new methods of interior illumination.

Interesting combinations of Modern with Period furniture predict an increasing appreciation of the traditional. And table settings, simple and elegant, occupy their share of attention. Besides the many half tone illustrations, there are sixteen color plates, tipped in, which depict settings of rooms and tables by famous decorators from England and the United States. Surely a book for home decorators as well as professionals.

HERCULES POWDER CO. HAS RECENTLY PUBlished a 40-page booklet titled "Finishing Problems and Suggested Solutions." A feature of the publication is a comparison of properties of Hercules raw materials for protective coatings such as nitrocellulose, cellulose acetate, ethylcellulose, Hercose C, Hercose AP and Tornesit.

THE TECHNICAL SERVICE LIBRARY, WHICH IS the service organization of Rex Campbell & Co. Ltd. at 10 Cross Lane, London E.C.3., has sent a revised list of the book and reference materials available at the Library. Anyone interested in consulting this reference may do so at the office of MODERN PLASTICS.

The Library exists to provide a technical service of books and articles for chemists, production managers and students engaged in the paint, lacquer, plastic and allied industries of the United Kingdom, but since the bound copy of the reference list has been sent to us for review we assume that this service has been extended to our readers in the United States.

F. J. STOKES MACHINE CO. HAS ISSUED A FOLDER which illustrates and describes its No. 200 Automatic Plastics Molding Machine recently announced. It explains the simplicity of operation and outlines the advantages of this advanced method of thermosetting plastic production.

LUKENWELD, INC., DIVISION OF LUKENS STEEL Company announces a hydraulic press with non-deflecting, continuous welded frames. These are illustrated in an eight-page folder showing the construction of the press with a typical installation. The welded, continuous type of frame, designed and fabricated by Lukenweld, Inc., was chosen largely by the desire to minimize the weight of the press and obtain the maximum rigidity possible, particularly from the standpoint of eliminating bending deflection in the platen. Another advantage of this type of frame is its ability to stand concentrated loads and equal tension in both sides of the frame irrespective of stretch. There are no bolts or nuts in tension and alignment does not depend on machined surfaces.

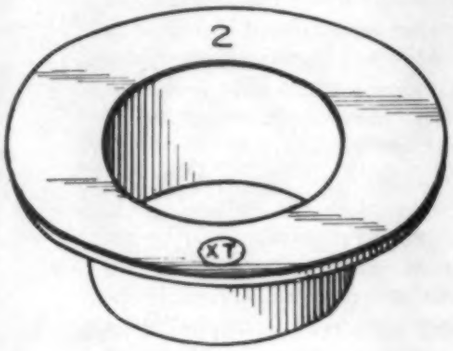
THE PYROMETER INSTRUMENT CO., ANNOUNCES the introduction of a new instrument—the Pyro Micro-Optical Pyrometer which is fully described in their catalog No. 90 just published.

"WHAT TO DO ABOUT TUNG OIL SHORTAGE" IS the title of a booklet recently published by Hercules Powder Co. It sets forth three suggestions in which nitrocellulose lacquers, ethylcellulose, and Tornesit can help the situation, detailing the properties and methods by which they can be employed to relieve the emergency.

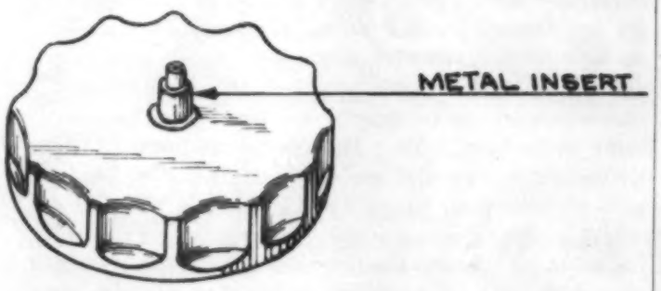
MOLDS FOR PHENOL RESINOIDS

(*Continued from page 40*) out holes in the bottom of the chase previously described. Some manufacturers use what is termed a "progressive knockout plate" which combines all necessary knockout facilities of the mold in one plate.

Four flash overflow type molds are now being used for the production of Navy designs of molded phenolic pieces, the designs of these pieces being relatively simple. Two of these molds are single cavity, hand type and the other two are multi-cavity, semi-automatic. The weight of each of the hand molds is approximately 30 pounds, whereas the weights of the two semi-automatic molds are 118 and 300 pounds, respectively. For the pieces concerned, all of which are molded from woodflour filler material, the application of the flash overflow type of mold is correct, as is the multi-cavity classification for two of the molds mentioned. The use of the semi-automatic classification, however, is not justified by the



MOLDED BUSHING



MOLDED CAP

FIG. 11.

production required for the particular pieces. It is of interest to note the excessive weight of the semi-automatic, multi-cavity molds as compared with the single cavity hand mold.

Figure 2 shows two typical designs of molded pieces which are suitable for production using flash overflow molds. (*To be continued in January.*)

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CHANGES IN FINISHING MATERIALS

(*Continued from page 36*) any reasonable degree of air-drying ability. The acids of certain semi-drying oils may exert either a much greater drying effect than would be expected from the nature of the oil, and yet in many other cases the drying properties are far inferior to those expected from the oil-acid modification. Furthermore, in the case of a castor oil acid modified alkyd (castor oil is always classified as a non-drying oil), there is often an unexpected drying effect caused by the partial conversion of the ricinoleic acid in the castor oil to octadekadienic acid, as described by Fritz,[8] and Scheiber,[24] unless care is taken to prevent this. The non-drying alkyds are used in lacquers where positive protection from "lifting" is necessary. In other words, when a second coat of lacquer is sprayed over the first coat, the second one must not partially dissolve the first and produce a disagreeable wrinkly appearance together with a tendency of the damaged film to peel off on abrasion. The semi-drying alkyds are used principally for their

Equipment for manufacturing oil-soluble phenolic resins

non-yellowing possibilities, that is, for such specific purposes as white high bake refrigerator enamels, and for brushing architectural whites. The drying type alkyds are used in abundance both for air-drying and baking finishes. Alkyd resins modified with China wood oil in general have superior hardness and marproofness. If the China wood oil is not processed correctly, however, wrinkle finishes tend to result whether they are desired or not.

House paints today still bear a very close relationship to those made at the beginning of the century except that the vehicles are lighter in color, the pigments newer, whiter and lower in oil absorption. Both vehicles and pigments are much more thoroughly pre-tested in all sorts of formulation for years before being submitted to the paint manufacturer. In many house paints, the vehicles consist of bodied oils reinforced by "long oil" alkyds to increase the luster life and durability. In many trim paints, the whole vehicle is alkyd. Until recently, alkyd resins in general have not been as brushable as oil paints, but now modern white alkyd enamels brush so easily that in many cases they are easier to apply than the older house paints. The white marine enamels, which are used where dependable whiteness and gloss retention are required, are all alkyd.

"Cold water paints" and "distemper" paints were well known before the beginning of this century and described in many old recipe books, such as the one by Jameson.[13] They usually consisted principally of emulsions of organic esters (drying oils) dispersed in a system consisting of an alkaline colloidal solution of protein matter in water. Even as far back as 1860, Emerson disclosed the idea of making a water paint from an ester, such as flaxseed oil, emulsified in an alkaline suspending medium. The rejuvenated cold water paints of today are much the same as they were before the beginning of this century except that they are revamped by replacing the bodied drying oil with alkyd resins to improve the drying, color and durability. Alkyd resin emulsions have been found by Gardner[6] and the author[12] to have excellent exterior possibilities, especially over asphalt where "bleeding" of the asphalt into the paint must be prevented when it is being used.

In order to get away from the inflammability and other hazards of cellulose nitrate, many new and interesting cellulose derivatives have been prepared. Probably the most interesting at the present time is ethylcellulose. Curiously enough, the phenolic resins which are in general incompatible with cellulose nitrate in most proportions are highly compatible with ethylcellulose. Among the materials which appear to be the most interesting for use with ethylcellulose in coatings are the 100 percent phenolic resins, the modified-phenolic resins, ester gum and Beckolin. The "short" alkyds in general are very incompatible but the compatibility increases with the oil length, the very "long" alkyds being quite compatible. The phenol modified alkyds which are oil extended are also compatible in certain proportions. Bass, Kauppi and Sherk[1] have published a valuable paper discussing the properties of ethylcellulose when modified by various resins and have used load-elongation curves to present considerable quantitative data. The discovery of the compatibility of the large variety of phenolic resins with ethylcellulose in work which was intended for the paint, varnish and lacquer industry may be of considerable interest to molders, especially when ethylcellulose becomes more plentiful.

During this century, colloidal chemistry both from the standpoint of theory and practice has been developed to a high degree of efficiency. It has long been known that high molecular weight organic substances, such as bodied oils and resinous materials, have colloidal properties. One of the oldest references on this subject is Krumbhaar's[18] paper in 1916. Between 1923 and 1927 there was a growing realization that while the high

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molecular weights of colloidally dispersed substances could not be measured for each individual colloidal particle, an average value could be taken which would be of great value in determining the changes in chemical and physical properties of the substance as a whole. Prior to that time, the high molecular weight colloidally dispersed systems were regarded with much awe and mystery. The splendid work of Rhodes and Welz[22] on China wood oil and of Long, Egge and Wetterau,[20] and Long, Knauss and Snull[21] on linseed oil showed distinctly the changes in the average molecular weight of these oils upon various types of chemical treatment. These papers showed very clearly that the large-sized aggregates were built up gradually and continually from the smaller ones. This tied in very well with the work which was going on at the same time on alkyd resins and so, through correlation of this work on oils with the work done on alkyd resins, a very clear idea of what happens in the case of the drying oil-acid modified alkyd resins has been made possible.

Due to the fact that the progress of the alkyd resin reaction could be followed by knowing at any stage of the reaction the concentration of one of the ingredients, i. e., the polybasic acid, the work of Kienle,[14,15] and the author,[11] on the reactions of phthalic anhydride with both glycerol and ethylene glycol threw much light on how other types of resins were formed. In the case of alkyd resins, there must be an alcohol with at least two hydric groups and an acid with at least two carboxyl groups or else a corresponding anhydride. Ethylene glycol with only two hydric groups forms a permanently fusible non-convertible resin with the difunctional phthalic anhydride when no modifying agents are used, whereas glycerol with three hydric groups forms under the same conditions a resin which quickly gels at between 69–72 percent of esterification. From such facts as these Kienle[16] and the author[11] were able to state that synthetic resins are formed only when there is more than one point of reaction on each combining molecule which permits the formation of long molecular chains instead of simple compounds. Therefore, when one is attempting to pick out resin-forming chemicals, it is necessary that there be on the molecule two or more functional points of reactivity which are capable of reaction with two or more reactive functional groups on another molecule. Such a useful generalization not only enables one to eliminate a great many substances from consideration for resin formation, but it also points out many possibilities in resin formation which one might otherwise overlook. Even if a molecule is only monofunctional it may have infinite value as a modifying agent even though it is powerless to form a "family" of resins. For example, lauric acid cannot form a family of resins such as the alkyd family as phthalic anhydride can, but nevertheless, it is of infinite value as modifying agent in the formation of non-drying alkyd resins for use with cellulose nitrate in lacquers.

More recent papers by Bozza,[2] Savard and Diner,[23] Kienle,[17] Bradley[3] and the author[12] have continued the study of alkyd resin formation and of resins in general, but nothing has appeared which makes any serious challenge to the original generalizations.[11,16]

Hoenel[7] and Krumbhaar[19] have given an excellent description of the mechanism of the reactions of the heat-hardening oil-soluble phenolic varnish resins of the reactive type. The phenol-aldehyde reactions which cause the quick-curing of molding resins has been discussed by Houwink[9] in great detail, more particularly with regard to the suddenness of the transition process from sol to gel. He pointed out that the conspicuous ease with which the phenol-aldehyde reaction can proceed remains unexplained. Very recently Scheiber and Barthel[25] have presented an extremely interesting explanation of why the hardening of phenol-formaldehyde molding resins takes place with such rapidity. They point out that the longer the chains become, the better the chances are of their becoming very much longer. If the phenols have all positions free, a chain composed of n phenol nuclei has no less than $n + 2 = N$ reactive points. Thus the combination of such chains to a structure with twice as many nuclei gives $N/2\,(N + 1)$ possibilities for orientation. Orientation becomes easier and easier as the chain length increases. This not only explains the tendency toward a resite ("C" stage) formation, but also the reason for the abrupt direction transition to the resitol ("B") and the resite ("C") stages.

It will be seen that while this explanation of Scheiber's[25] is practically another way of saying the old familiar principle that large colloidal particles grow at the expense of smaller ones by attracting them, nevertheless the chemical structure of the reacting molecules play a very important part not only in the properties of the resulting resinous product but also in the velocity of the reaction and especially in the time necessary for gelation to take place. If one of the two ingredients has a functionality of only one, resinification cannot take place at all. If both ingredients have a functionality of two, resinification is possible, but gelation cannot take place. It is well known that gelation occurs if the functionality of one of the ingredients is more than two, because the resulting cross-linkages between the linear structures promotes rigidity, and it is generally conceded that gelation occurs even more rapidly if the functionality of one of the ingredients is higher than three. Thus, systems such as maleic anhydride (tetra-functional)-glycerol or phthalic anhydride-mannitol (hexa-functional) tend to gel quicker and at a lower degree of esterification than a system such as phthalic anhydride-glycerol (trifunctional), because the increased chances of cross-linkages increase the tendency to form rigid structures. In other words, if the situation were compared to a Paul Jones dance of the molecules, in three-dimensional space, and if the dancing molecules were to have as many hands to clasp the hands of the opposite type of molecules as would compare with the number of their functionality and vice versa for the opposite type of molecules, an interesting picture of resin formation may be visualized. Let us suppose there were no personal preferences permitted—just merely the all-powerful attraction of the

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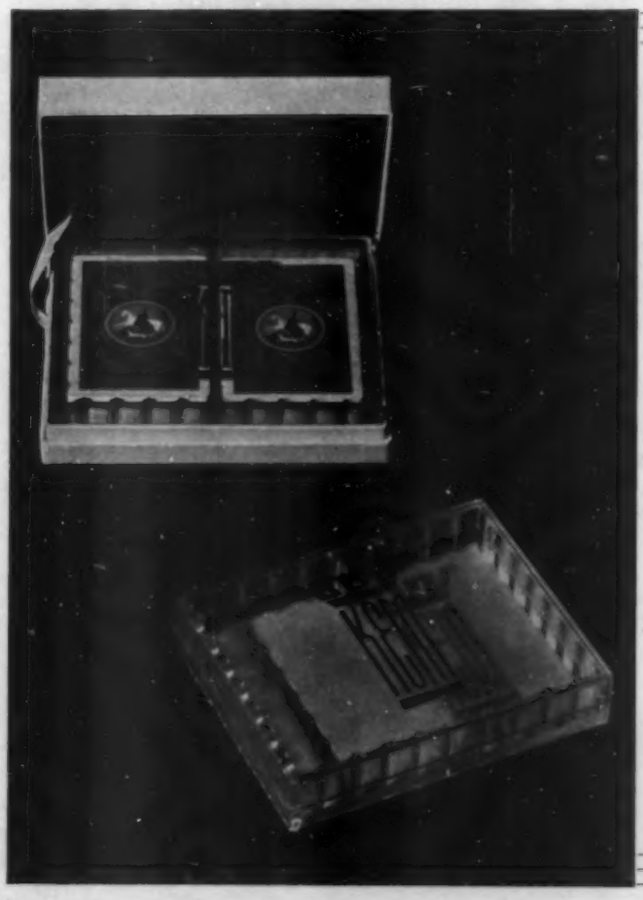

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hands geographically nearest to those of the opposite type. It can then be seen that the more hands (functionalities) the molecules have the quicker that dancing molecule will be tied up by several other moving molecules of the opposite type which are searching for partners to satisfy the all-powerful attraction and which are competing for the attention of this molecule and which are also at the same time being partially tied up by others. Soon no independent motion will be possible. Chains of tied-up molecules physically prevent any partially tied-up molecules or any "wall-flowers" from wandering around. This corresponds to a state of gelation. Remembering that a gel may be swelled but not dissolved let us carry the analogy still further. Even though an impassé has been reached in the three-dimensional Paul Jones dance of the molecules, just described, corresponding to restricted motion of the molecules and gel formation, a large number of smaller imps may crawl underneath the arms of the tied-up dancing partners and penetrate to more or less distance toward the middle of the aggregates. Some of the imps might even find some uncombined hands (functional groups) on to which they could join hands (combine as in "solvation" phenomena). When enough of these imps go in, they will exert a pressure akin to the swelling pressure exerted on a gel by a solvent, but they do not break up or disperse the large complex structure nor carry its component parts along with them as they could do with smaller and weaker aggregate groups. If that were possible, the phenomenon would be a true solution.

The success of the three great resin "families," i. e., phenolics, alkyds and ureas in the plastics and coatings industries have stimulated a boundless amount of research on other resin-forming ingredients. The resins which have been made from unsaturated hydrocarbons described by Thomas and Hochwaldt have been very interesting to the coatings industry because of the alkali resistance and their potential cheapness, but they have not been able to compete with the para-coumarone-indene resins on account of cost nor with the modified phenolics which have greater ease of handling in varnish manufacture as well as the advantage in cost. Water-white resins, such as the methyl methacrylate type and the urea-formaldehyde condensation products are coming along fast for coatings which require very special properties, although not as fast as they have gone in the plastic industry. In thin films, differences in color and in transparency do not make such vast differences as in molded objects. Both these resins are still relatively expensive for coatings and unless the end justifies the material, it is not adopted. Urea resins for finishing purposes are much more tricky than those used for molding purposes on account of the difficulty in compatibility with the cheaper materials used in coatings which still consist mainly of materials which are soluble in hydrocarbons. Much work will have to be done and many headaches will have to be fought off before safety and success in urea resin coatings are assured, but enough has been done to show that urea resins have come to stay. While phenolic resins have been used both for moldings and for coatings the alkyd resins have not made much progress in molding nor have the ureas made much progress in coatings. It is expected that these two families will invade the undeveloped field which has hitherto been neglected.

While there has been great progress in the coatings industry since the beginning of this century, this progress is probably nothing to that yet to come. We have the demands of the ideal finish to be met. While one finish can hardly be expected to be universal, nevertheless, there are the following demands on an ideal finishing material—water-whiteness and transparency; adhesion; hardness and marproofness; sufficient flexibility; perfect insulating qualities; complete resistance to steam, acids and alkalies; perfect weathering qualities; freedom from objectionable odor and toxicity, to say nothing of its being as cheap as porcelain. When one looks back at the finishes of 1900, he can see that we have gone a long way since then, but when one looks at this list of formidable properties as the goal he begins to wonder if we have made much progress at all. We are much interested in hearing of new low cost resins and at the same time we, as a part of industry, are anxious to help the farmer in a chemurgic program. Yet, on the other hand, there is the brilliant handwriting on the wall in the form of some of these newer resins which are being made without one single material of natural origin in them. The coatings industry today is a large consumer of agricultural products, such as drying oils, glycerine, rosin, casein, etc., and much higher prices are the result. In contrast, research forces are striving to develop better materials at lower cost from air, coal, petroleum and natural gas. Regardless of the social and economic adjustments to be made, it appears that finishes will continue to become better as well as cheaper, just as they have been doing all this century.

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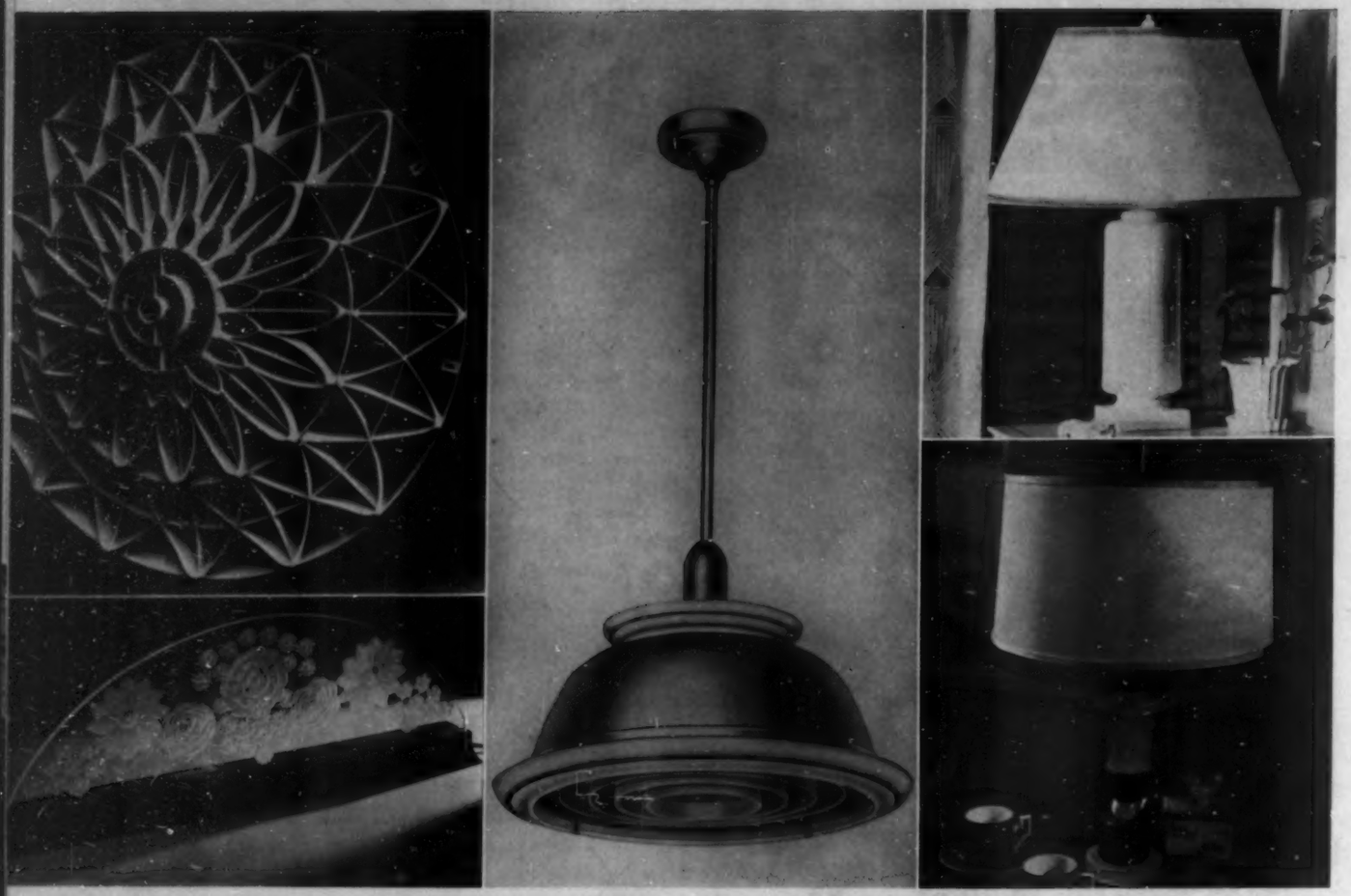

Upper left—36 in. lighting fixture for retail store use made up of small Tenite parts cemented together. Molded by the Gorham Co. Lower left—Mantel light carved by C. K. Castaing in which the edge-lighting qualities of Plexiglas are well illustrated. Center—New Westinghouse Storelite Luminaire in which Lumarith is used as a diffusing element. Upper and lower right illustrate the attractive use of cellulose acetate as lamp shade material. They are made from Plastacele and Lumarith, respectively

for better vision—BETTER LIGHT

(*Continued from page 21*) and untried conditions will crop up from time to time which will probably be met and overcome by the trial and error method. But there is a sincerity of purpose behind the research work being carried on by manufacturers and molders which will gradually reveal the advantages of organic plastics in a way that all may understand.

In recent years, urea plastics have become more and more important for transportation lighting since higher speeds of travel and more rigid safety codes demand non-fragile, light-weight illuminating devices that will withstand constant vibration and shock. In addition to their adoption by railway and Pullman companies, these plastics have slowly but surely crept into the good graces of the automotive industry where they serve as dome and pillar lenses, dashboard instrument dials, bus lighting diffusors and safety installations of one kind or another. Nor are they forgotten materials for aviation lighting, but do their bit as instrument dials and cabin reading lamps. Because metal inserts can be molded directly into the plastic fixture, and metal heels can be crimped or stapled on without danger of fracture, plastic reflectors can be used frequently for such purposes where their equivalents in glass have been impracticable. Although not actually unbreakable, they are shatter proof and should a fracture occur, it would more or less take the form of a crack in the material which could do no harm to the traveler.

Full advantage has been taken of the many soft pastel colors available in urea plastics for the advancement of these materials in home lighting fixtures, for they may be planned to carry out practically any decorative scheme in livingroom, bedroom, kitchen or bath. To the overhead fixtures first introduced for home use have been added wall fixtures, occasional lamps and bed lamps exemplifying a congenial combination of plastic and metal; at the present time two types of diffusors are being made for home use according to specifications of the Illuminating Engineering Society—one of these is an 8-inch reflector to be used with a standard 100-watt bulb

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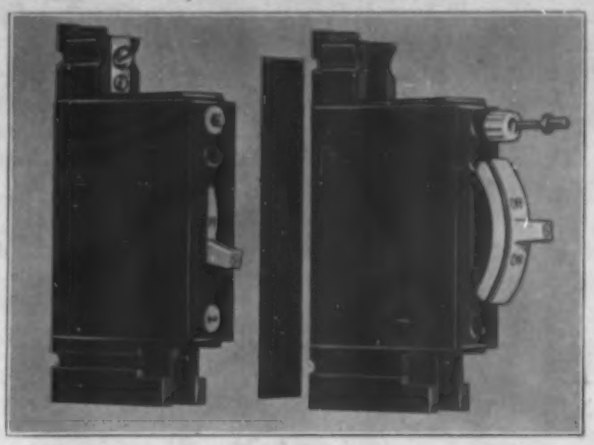

Combining Plastics for Utility

That a sound combination of molded plastic materials can be used to gain practical advantages other than appearance, is shown by Frank Adam Electric Company's new circuit switch, here illustrated. The bright red signal button shows at a glance the position of the switch, regardless of whether or not the lettering can be read.

The button, button casing, and switch handle are molded of cellulose acetate, reducing mold cost and increasing production. The case is of phenolic material.

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in table study lamps; the other meets requirements for a 9⅜ inch diffusor commonly used with a 50, 100 and 150 watt light bulb in bridge lamps as well as table lamps.

Four-inch candle shades have become standard on I.E.S. 6-way lamps. Schools, libraries and hospitals as well as many business establishments prefer reflectors of plastics, because besides being efficient lighting fixtures, they are sanitary, easy to keep clean and because they eliminate the danger of serious personal injury should they fall.

NOWADAYS MOLDED PLASTICS ARE DETECTED in innumerable other lighting applications oftentimes replacing glass and in practically every instance doing the job in a thoroughly satisfying manner. The reason for this may be appreciated by a brief comparison of urea plastic with glass as set forth in the following Table I:

Because urea plastics are not subject to breakdown when exposed to sudden changes in temperature, they may, under some conditions, be used outdoors for lighted advertising signs such as are often seen on gasoline pumps where they are particularly effective in color. Molded translucent urea dials are rapidly replacing cardboard and cellulose in recording meters, especially those used in boiler rooms and hydro-electric plants. Illuminated planetoriums and cove, louvered and fenestrated lighting supplies also make generous use of these plastics.

Plastic reflectors have certain advantages when it comes to assembling them to husks and lamp bases. Metal inserts may be molded into the reflector to which may be screwed metal stampings; holes are sometimes molded in, which are later threaded or used directly with self-tapping screws. Whenever desired, it is possible for threads to be molded into the reflectors.

LAMINATED UREA WILL BE FOUND IN FIXTURES for indirect lighting. They lend themselves to the translucent planes so popular in modern design and because of their rugged construction are dependable for long periods of service. Laminated plastics differ from molded plastics in that they are available in sheets of different thicknesses which can be sawed, drilled, fitted to shape.

This subject of laminated plastics in illuminating fixtures should not be dismissed so briefly. Amazingly interesting things are being done which we shall present as a complete story in a later issue.

Molded urea plastic frames for supporting illuminated gasoline advertising display

Space at this time will not permit any lengthy discussion of other types of plastics in lighting equipment but it must be remembered that phenolics,[1] both cast and molded, have been employed for a good many years. Cast phenolics[2] give color and grace to portable lamps and have been used as louvres in commercial applications in elevators and office buildings. Molded phenolics were used ten years ago for overhead fixtures for office and factory lighting, supporting bowls and reflectors of glass. They are still used in many places where translucence is not a requirement.

Cellulose acetate is used for the majority of home lamp shades because of its soft translucence, flexibility, and ease of keeping clean. Much has been accomplished in novel finishes and unusual patterns until almost any effect a designer may desire is available on short order. This material tailors easily, is light fast, non-inflammable and comparatively inexpensive. In thicker sheets

Table I

Properties	Solid Opal Glass	Cased Opal Glass	Urea Resin
Weight	Specific gravity about 1.6 times that of plastic. Minimum section, about .070 in.		About ⅓ that of glass. Minimum permissible section, about .025 in.
Temperature resistance	Quite high for continuous temperature 390 deg.–480 deg. F. probably safe.		Relatively low. 150 deg. F. cannot be exceeded continuously. Sudden changes without effect.
Lighting efficiency	Comparable with plastic		Comparable with glass
Color	Somewhat limited commercially, particularly as to reproducibility		Infinite possibilities without increased cost
Surface	Limited commercially as to decoration		Little limit on decoration and finish.
Dimension tolerances	Relatively large		More accurate than glass.
Fragility	Strong but easily shattered, more hazardous		Stronger and less easily shattered, partly owing to light weight. No hazard from fragments.
Cost	Comparable		Comparable.
Optical properties	Unlimited from transparent to opaque white		Translucent to semi-opaque.
Machinability	Simple grinding and drilling only		Less necessary because molding conditions permit more complicated design.

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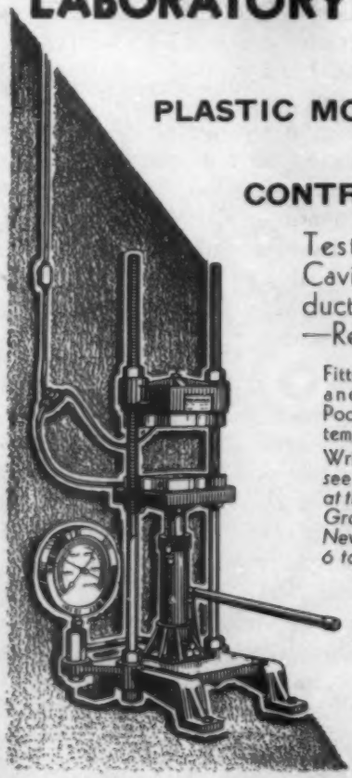

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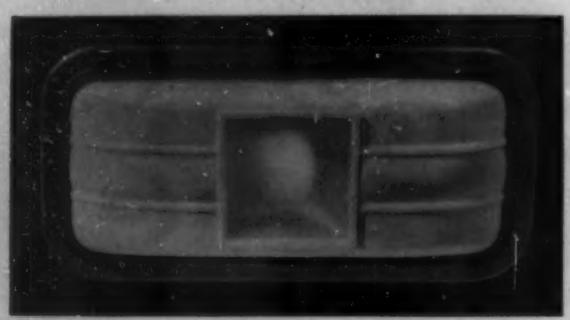
Characteristic examples of automotive dome lenses of molded urea plastic

it has been used as bus light reflectors and for tail lamps on automobiles.

One of the latest developments in department store lighting discards aluminum previously used, for an ivory colored cellulose acetate. The huge fixture (illustrated), designed to hang from the ceiling, is built up of leaf-shape sections formed by compression molding, and cemented together. The old aluminum fixture weighed 58 pounds as compared with a weight of 7 pounds for the plastic version and besides this desirable feature, the translucent plastic has a radiant warmth entirely lacking in the metal.

IN CLOSING, WE MUST POINT TO THE ACRYLIC resins[1] such as methyl methacrylate,[1] which indicate a new departure in clear transparency of organic plastics. They are claimed to be the optical equivalent of quartz crystal and are reported to possess greater light transmission qualities than any glass. Like cellulose acetate, they are thermoplastic but have an appreciably higher softening point[2] and, it is claimed, may be frequently used at temperatures above those normally recommended for the urea plastics.

These materials can be injection or compression molded and are available in sheets 36 by 48 inches, ranging in thickness from $^1/_{16}$ to $^1/_2$ inch. Surfaces can be scratched but in wall thicknesses of more than $^1/_4$ inch the material is exceedingly difficult to fracture. It does not shatter and broken edges are not dangerously sharp. Edge lighting is one of its advantages which recommend this type of



Bus light with urea diffusor, molded for The Miller Co., by Waterbury Button Co.

resin to decorative architectural effects, especially in the construction of indirect lighting fixtures. The material may be pigmented or dyed with practically no loss of transparency and beautiful colorings result. By proper pigmentation any desired degree of opacity may be obtained to meet requirements of transmission or reflection.

Although it has been necessary to treat the different types of plastics briefly at this time we expect to be able in an early issue to present a more technical version of the lighting properties of plastics, especially the ureas. We believe with Dr. Luckiesh that a tide of demand for more light and better lighting is rapidly rising and we believe, too, that decorators, lamp and lighting fixture manufacturers, architects and others who in the future will meet this demand, will find in plastics of one sort or another an exceedingly useful and efficient material.

[1] Described fully in Modern Plastics, October 1937.
[2] Plastics Properties Chart Modern Plastics, October 1937, gives comparative physical characteristics of all other organic plastics.

EXPANSION OF PRODUCTION

(*Continued from page 44*)

GEOGRAPHICAL DISTRIBUTION OF GERMANY'S EXPORTS OF SYNTHETIC RESINS

Country of Destination	*1934*	*1935*	*1936*	*First Six Months 1936*	*First Six Months 1937*
	(In 1000 Marks)				
Austria	259	352	446	188	226
Belgium	215	259	297	155	199
Czechoslovakia	347	345	604	305	378
Denmark	316	391	473	198	284
France	626	651	680	321	348
Great Britain	1247	563	596	250	423
Hungary	240	135	182	58	146
Italy	252	359	523	254	279
Netherlands	530	572	645	256	488
Spain	225	302	178	143	9
Sweden	415	457	463	210	339
Switzerland	721	705	714	306	396
Other Europe	370	618	706	287	503
Argentina	250	207	194	82	159
Brazil	46	77	109	33	122
Other Latin America	17	18	75	38	66
All Others	501	427	436	180	361
TOTALS	6577	6438	7321	3264	4726

TOYS

(*Continued from page 23*) by Herman Barr. The washstand is molded of a urea material with tiny depressions for basin and soap dish, and is finished with a thin stainless steel mirror attached to the back. It provides the miniature bathroom with realistic equipment which cannot be harmed in use. The bathtub is molded with little feet to enable it to stand securely and like the washstand is available in many colors to match.

Doll furniture in the modern pattern has been successfully molded in England for some time. Complete bed room and dining room suites as well as living room and occasional furniture become very practical when made of these sturdy plastics with their permanent finish. Combined with miniature metal tubes and rods they provide children with an educational device to stimulate

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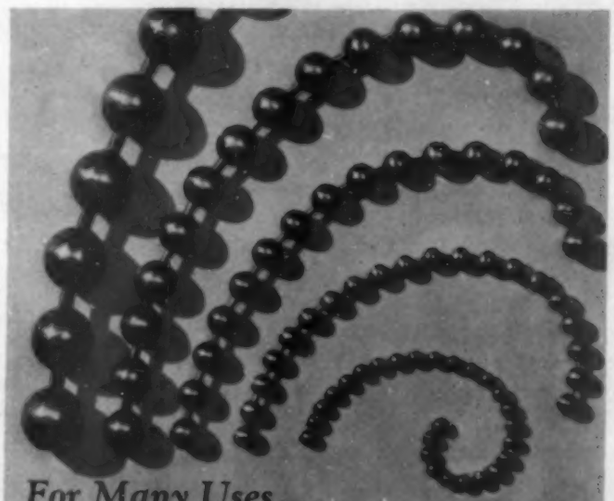

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their imaginative minds with a natural opportunity to develop a sense of home decoration according to their own ideas.

Floating toys in most instances are made of cellulose acetate or cellulose nitrate and these have been in existence too long to describe in any detail here. They may be found in the form of ducks, fishes, geese and swans, as well as in a wide variety of barnyard animals including pigs, cows, horses and dogs.

These are but a few of the many ideas in which plastics have found a natural outlet and it is hoped that by presenting them at this time, other toy manufacturers will be encouraged to create molded toys before another Christmas season rolls around.

ARCHITECTURE

(*Continued from page 25*) which, indeed, seems incompatible with static structure. If, at times the outward forms of turbines and dynamos do attain a geometric elegance and a thrilling sense of power, this is neither the formalism nor the power of the Roman dome and the Gothic tower whose weight and permanence are more like those of the cavern and the mountain. Because these are like some majestic phenomena of nature and yet transcend nature in the completeness and harmony of their forms, the classic monuments command our imaginations in a manner impossible to the products of modern industry. I think that we must accept the fact that the peculiar grandeur of the monumental form will be forever denied that new architecture whose outward aspect is—or should be—that of thin and half-transparent membranes hung on light metallic frames.

A compensatory resource lies at our hand. This new structure, which has robbed our patterns of weight and of the Platonic beauty of sphere and cube, has given us, in a new quality of space, and in a new command of space, a material of expression not less valuable than those we must lose.

Maholy-Nagy has said that space is the only important concern of the architect. Structure exists, he tells us, to enclose space: to model it, define it, direct its flow and create from it three-dimensional volumes that are the abstract elements of our new patterns. Modern technique has set us free to arrange space as a sculptor arranges mass.

I do not share the view of those who believe that modern space will be formless. It will be, no doubt, less ponderously enclosed than in the historic architectures; the space of a tent rather than that of a cavern. It will be less evidently the product of geometric order; it will rely less upon balance, proportion and symmetrical rhythms. It will be at times mobile; its elements will interpenetrate; its separation from outward cosmic space will be less definite. Nevertheless, it will not be "indeterminate, indistinct, unshaped." If it does not attain precisely that quality of expressiveness which it attained, for example, in the majestic silence of the Roman Pantheon, or under the nervous arrested energy of the Gothic canopies, or in the crystalline patterns created by Renaissance intelligence, it will, nevertheless, be subjected to the same processes, intellectual and perhaps intuitional in character, which gave shape to these historic themes, and it will be, after an impredictable period of experiment, as eloquent.

Modern structure will of course be subjected also to these processes, but the role of structure—as Maholy-Nagy has said—will be less important than in the historic architectures. This will be true not only because space can be made to conform more precisely to function and because this exactitude can be made more evident and more elegant, but equally because space, the most abstract of architectural materials, will become in the new architecture the most resourceful. The modern architect has yet to learn the marvel of the new structural technique: its clarity, its etherial suppleness, its triumph over gravity and above all the new freedom which it gives in the ordering of intervals, in the relations of distances, in the harmony or contrast of measured or dissonant volumes. So varied, so powerful, so absolutely unhackneyed a medium must give our art—if not too closely confined by functional necessities—a range and freedom not unlike that of the musician, or, perhaps, more like that of the painter, who long ago made space relationships the basis of his art, in which line and light, shadow and color, mass and movement are accessories. Perhaps it is not too fantastic to predict in architecture qualities of space as varied and as eloquent. We shall have sensuous and radiant space like that of Poussin and poignant and warm space like that of Rembrandt; the confused mystic space of El Greco, the dynamic space of Cezanne. The promise of that miracle is at Dessau, at Rotterdam, at Hilversum.

Space to the industrial engineer is chiefly useful for the elbow-room it gives to mechanisms. His designs "occupy space with space around" and are, in that respect at least, more akin to works of sculpture than to buildings. Space—whether apprehended from the exterior as volumes defined by structure, or from the interior as shaped enclosures—belongs to the architect.

II. Human values as the materials of architecture

Thorstein Veblen, in his *Theory of the Leisure Class*, makes an interesting distinction between industrial and

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non-industrial occupations. That effort is to be accounted industrial, he says, only in so far as its ultimate purpose is the utilization of non-human things. Industrial activity is "an effort directed to enhance human life by taking advantage of the non-human element."

Industrial art, then, is that art which utilizes non-human things: the art of making pottery and airplanes, for example, but not the making of laws, of war and peace, of ecclesiastical ritual, or of sport. These latter "utilize human material"—as do also the arts of dancing of song, and of poetry.

Architecture, like the art of the theatre, utilizes both human and non-human materials. At least that is true of the historic architectures which are built as definitely from human affections and aptitudes as from stone and wood. Will that not be true of the new architecture? And if so, will not that circumstance distinguish our work, to some degree at least, from the work of other designers in industry?

I am not thinking of that sensibility towards distant and archaic things which is the cause and excuse for romantic survivals in design; nor of canons of taste; nor of that *horror vacui* which is the psychological justification for ornament; nor of any of those foibles and aberrations usually referred to as "human nature." Although I should sometimes admit sentiment and phantasy into my architecture (they are fortunately unavoidable) I shall not offer these as a defense for irrationality in design.

On the contrary, I shall imagine for my modern house a modern owner. His vision, his preferences, his habits of thought shall be those the most serviceable to a collective industrialized scheme of life. To him the world shall appear as a system of casual sequences transformed each day by the cumulative miracles of a machinery which has become the implement of the human spirit. Free from predatory habits, from clannishness and disingenuousness, this marvelous creation of the new sciences, this nonpareil of clients, shall possess no trait which might blur the clear apprehension of the cosmic mechanism.

Nevertheless, this client, if he remains human, will seek some opportunity for expression, and he will continue to find that opportunity in his environment. The need for expression will find its ultimate source, not in caprice, but in a way of life. Though his house is the most precise product of mechanized processes some aspect of life will demand an emphasis there. It will be the architect's task, as it is now, to comprehend that aspect of life—to comprehend it more firmly than anyone else—and to bring it out in its true character. Beyond the delight of the intellect in forms engendered by conformity to function, beyond patterns of space and of structure, there will be discoverable a way of life to be made express and visible.

The products of industry, however adjusted to human habits and ideals, are less likely than buildings to attain a deeply human significance. Although they are indeed eloquent at times of human achievement and aspiration—of our conquest over nature, of that ordered and controlled universe which is overcoming the confusion of the non-human world—these products are not, like buildings, the immediate theatre of a life whose impress they freely receive. If, indeed, houses are to be made in factories, it will be necessary for the architect to take possession of the factory; but he will remain, nevertheless, an architect.

I do not suggest that an architect should possess occult powers or any neurotic adaptations beyond those of other artisans. I do not excuse "dreamers" or that mushiness of sentiment with which architects sometimes cover up their technical deficiencies. I suggest, rather, that the work of the architect, whether as scientist or as artist, shall be sustained even in a mechanized world by cultural interests, by a penetrating and valid knowledge of that life of which his work is the outward clothing. Different as will be the terms of his new art, he will still illuminate the material world with inward radiances. His dwellings will be fashioned from domestic happinesses; his warehouses from commercial enterprise; his universities from a devotion to truth; and his cathedrals, will still be built of prayer.

III. The community as a material of architecture

As a practical activity architecture will reflect the prevailing methods of economic production, and in general, the more closely it is governed by such methods the more closely it will reflect the ideology of its time. This is a commonplace of history; and the corollary that whenever industry is mechanized architecture will also be mechanized is indisputable.

Architecture, nevertheless, is a social art; and since it is improbable, to say the least, that society will assume an exclusively economic character, or that economic law will for any appreciable time determine even the outward appearance of a civilization, we may reasonably assume that influences other than economic will be determinant in architectural design.

I have mentioned two of these; a third will find its origin in that warfare, in which architects and industrial designers are allied, against the mean, disordered, and inhuman shapes of our modern cities. Here, again, the architect will have a prescriptive role. In the development of new civic and regional patterns his art will have a scale and range which will transcend those of industrial designers; he will feel less insistently the tyranny of economic law; and he will find opportunities to admit to his designs wider and deeper social values. Not only will he address his art to the well-being of communities but he will seek to discover and bring out in his constructed forms the qualities of the collective life.

In the future more than in the past architects will, I think, conceive their patterns of space and structure and life as integral parts of the larger patterns of cities: of cities which are not fortuitous complexes of streets and building sites but which are themselves evolving and unified works of design, conditioned upon science, directed towards human good.

I do not imply that the work of the industrial designer is without social relevance, or even that that relevance is

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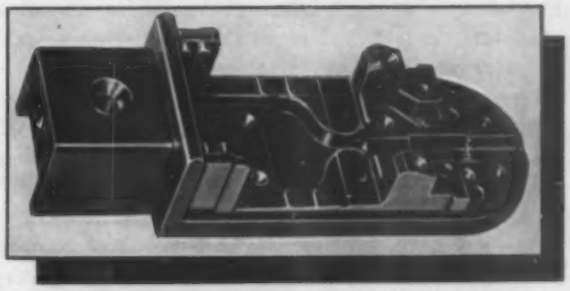

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vague or remote. Among those qualities which are possible to objects of manufacture and which are beyond those demanded by utility is the expression of a unity with the spirit of contemporary society; and it must be acknowledged that in many objects recently designed this unity is more persuasive than any which has yet found expression in modern architecture. In the presence of airplanes and steamships a condescension on the part of architects would be, to say the least, unbecoming.

I am thinking, of course, of that future architecture, of that architecture which shall seriously attempt a reconciliation with our mechanized world. Its materials will be, I am sure, the human spirit both in its individual and collective aspects no less than the products of industry, and to express that spirit it will, as always, make use of patterns in structure and space, in light and color, in movement and mass—yes, and in decoration also if this can be supported by some reference to reality. Although its basic unity with industrial design will be indisputable, architecture will yet be architecture.

PLASTICS FROM CORN

(*Continued from page 42*) such extraction an alcohol water solution of zein is produced consisting typically of approximately 10 percent zein and 90 percent solvent. The percentage of zein in the solution is then raised to about 20 percent concentration. A plasticizer which is compatible with the zein in the alcohol water may then be added, for example, 1 part of dibutyl phthalate to every 20 parts of zein. In addition to the dibutyl phthalate, it is stated to be often desirable to add a quantity of glucose up to 10 percent and higher to the solution before forming into sheets. Also, in order to insure that the film does not become cloudy in the sheeting and final drying operations, about 2 parts of triethanolamine to every 20 parts of zein is incorporated with the 20 percent solution.

The resulting compound is then run over or onto a suitable sheeting or filming surface and the solvent evaporated to produce the desired film. After the composition has been brought to a stage of coherency and preferably before complete drying is accomplished, the film is treated with a suitable tanning agent in liquid or gaseous form, such as formaldehyde. An important characteristic of the composition is said to be the quick drying which may be accomplished because the solvents employed are largely alcohols and the materials do not have a tendency to devitalize at relatively high temperatures.

Another patent relating to a transparent waterproof sheeting which may be made from material obtainable from corn is U. S. 2,012,344, issued August 27, 1935, to H. A. Levey. The base film is composed of a treated carbohydrate of lower molecular weight than cellulose, and preferably starch. The raw starch may be from corn, potato, arrow-root, rice, cassava or the like, the toughest and strongest films having been observed to be produced by cassava starch.

The following illustration of the process of preparing such films is given by the inventor. Cassava starch finely powdered is macerated with about six times its weight of water to which has been added about 1 percent, based on the weight of the water, of sodium or ammonium hydroxide and about 1 percent of glycerol. This mass is heated with stirring in a water jacketed vessel, preferably of glass to avoid discoloration. The heating is complete when the mass is a smooth slightly turbid jell nearly free from lumps. This is filtered under pressure through a very fine screen. This solution is then spread upon a clean piece of glass, which may be greased slightly, as, for example, with an approximately 1 percent solution of stearin in benzene. The solution is gaged down to the film of the desired thickness with a knife, while the superfluous portion is returned to the storage vessel. When the film has dried, it is peeled off the glass plate and dipped in a solution of cellulose nitrate made up of three parts by weight of cellulose nitrate, one part of tricresyl phosphate and about fifty parts of butyl acetate or an equivalent amount of mixed solvents and diluents. This will produce a coating on the starch film (which should be about 0.001 inch thick) of about 0.0001 inch thick. Coloring matter and pigments may be introduced into the starch base and the cellulose coating solution as desired.

In addition to the use of starch itself, this patent states that many of the derivatives of the starches and sugars may be used, such as their esters and ethers and starch xanthate. The starch acetates are especially suitable as they are stable and relatively cheap. The patentee states that his experiments have shown the mixtures of treated starches with a starch ester, such as starch acetate or starch nitrate, produced more desirable films than either one alone. The addition of the starch ester gives excellent binding properties when included in the plastic used for the manufacture of the starch film base, resulting in a film of substantially greater strength. If the starch-derivative is to be made more flexible, plasticizers may be added, such as glycerol, glycol, the acetins and other miscible, water-soluble organic compounds.

If the cellulose derivative coating solution, which is used to waterproof and to improve the transparency, strength, flexibility and brilliancy of the surface of the film, is relatively dilute and very fluid, it will penetrate the film, whereas if it is concentrated and very viscous, it will form a surface coating layer rather than penetrating. The degree of penetration may also be increased by adding to the coating solution organic solvents containing hydroxyl groups, such as methyl or ethyl alcohol, ethylene glycol, the glycol ethers and the like. It was also observed that when employing a film base made from a treated starch mixed with a starch ester, penetration resulted to a considerably lesser degree than when the pure treated starch alone is used, so that a film of the former type should be subject only to the coating process and not to the impregnation treatment. While cellulosic coatings were preferred the possibility of utilizing other materials such as the oleo-resinous varnishes, phenol-aldehyde and other synthetic resin varnishes and solutions of natural resin gums for the same purpose is noted.